UNITED STATES · ENVIRONMENTAL PROTECTION AGENCY ·

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Cost Evaluation Project:

U.S. Department of Energy-
Hanford Site

Conducted by:
Washington State Department of Ecology
United States Environmental Protection Agency

printed on recycled paper

October 1990
90-44

PREFACE

On May 15, 1989 the United States Department of Energy (USDOE), the United States Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) entered into the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement or TPA). The principle purpose of the TPA is to establish specific milestones to achieve site cleanup and compliance with Federal and state environmental laws. Moreover, the TPA requires USDOE to request sufficient funding for its full implementation.

Ecology and EPA recently became aware of new USDOE-Richland (RL) estimates for implementing the TPA. These estimates for FY 91 totaled $908 million, some $276 million more than the $632 million in the presidential budget request which was, in part, based on previous estimates provided by USDOE-RL. Final resolution of USDOE-RL's budget for FY 91 has yet to occur.

These potential shortfalls are of considerable concern to Ecology and EPA. At issue is the integrity of the TPA itself, a document which contains specific measures to ensure that proper waste management and clean-up efforts are adhered to in the years to come.

Given this concern, Ecology and EPA undertook a limited study in order to assess the degree of confidence they should place in the budget estimates provided by the USDOE. The study is a joint effort and is organized into two distinct sections. Section one consists of Ecology's evaluation of three TPA projects being initiated under the Resource Conservation and Recovery Act, and section two consists of EPA's evaluation of those TPA projects initiated under the Comprehensive Environmental Response, Compensation, and Liability Act and that are related to specific site operations. Ecology and EPA have also raised specific issues and, in some cases, have made recommendations for cost reduction measures based on their experience with other facilities.

These evaluations focused on three areas: 1) who makes budgetary decisions and how are budget estimates prepared; 2) what costs have been incurred or are estimated to be incurred for the selected projects or activities; and 3), how do these costs compare to those costs associated with similar activities at other facilities or in the private sector.

Ecology and EPA thank the individuals within USDOE-RL and its contractors who spent significant amounts of time with the study teams. Additionally, Ecology and EPA thank USDOE-RL management for its willing participation in this effort.

RECOMMENDATIONS

The scale of the Hanford clean-up is unprecedented, and the overall costs of the 30-year effort will be enormous. Given these conditions, USDOE-RL must demonstrate effective management, provide rigorous oversight of its contractors, and maintain prudent cost control mechanisms throughout the clean-up effort. USDOE must assure the public and Congress that the clean-up is conducted to the highest standards of cost-effectiveness, while complying with applicable regulations and keeping current with technical developments.

It is in this context that Ecology and EPA undertook a limited assessment of the budgeting and cost control practices of USDOE-RL and its contractors. In general, Ecology and EPA conclude that the management and budgeting practices of USDOE-RL and its contractors are inadequate to ensure the development of valid cost estimates and efficient use of funds. Further, USDOE oversight of its contractors' budget development and decision-making process is inadequate.

Based on these findings, Ecology and EPA find sufficient cause to recommend that USDOE-RL arrange for an independent, in-depth evaluation of the management, budget, and cost control practices of both USDOE-RL and its contractors. To accomplish this, USDOE should consider using a nationally recognized management consulting firm with strong expertise in project management. The objectives of such an evaluation should be to identify measures to strengthen management controls and financial analyses, and to improve the accuracy and credibility of cost projections. The results of such an evaluation could lead to the development of incentives for cost control and reduction. Ecology and EPA also recommend that USDOE establish a continuing budget and cost control review program.

COST EVALUATION PROJECT

SECTION 1

U.S. DEPARTMENT OF ENERGY
HANFORD SITE
RICHLAND, WASHINGTON

conducted by

Washington State Department of Ecology

With Assistance From

Brown and Caldwell Consultants

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I. INTRODUCTION

A. BACKGROUND

On May 15, 1989 the United States Department of Energy (USDOE), the United States Environmental Protection Agency (USEPA), and the Washington State Department of Ecology (Ecology) entered into the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement or TPA). The principle purpose of this Agreement is to establish specific milestones to achieve site cleanup and compliance with Federal and state environmental laws.

As in any large scale environmental compliance and clean-up activity, costs are of major concern. This is particularly true in the case of the Hanford Reservation, where the scope and complexity of environmental issues are of an unprecedented nature. To help ensure that cleanup activities would be accomplished as set forth in the TPA, a component of the TPA requires the USDOE to request sufficient funding for its full implementation. For example, in FY 90 the USDOE secured $470 million to fulfill this commitment. As part of the FY 91 Five Year Plan, USDOE estimated that $658 million would be needed to implement the TPA in FY 91.

In the spring of 1990 Ecology became aware of new USDOE-Richland (RL) estimates of cleanup costs. These estimates for FY 91 totaled $908 million, some $276 million more than the $632 million in the presidential budget. The USDOE-Headquarters (HQ) response to these increasing cost estimates was to question their validity, and Richland's ability to spend monies efficiently. According to USDOE-RL, the higher estimates result from Richland's better understanding of the problems, and reflect a new scope, improved cost estimates, and a clearer interpretation of the environmental regulations.

These shortfalls are of considerable concern to Ecology. Most importantly, budget shortfalls could mean that the environmental cleanup, long sought-after environmental controls on continuing discharges, and the development and implementation of alternative waste treatment and disposal management methods could be delayed. Such delays would almost uniformly cause further environmental degradation and increased costs above and beyond that which is already forecast.

B. PURPOSE AND SCOPE

Given this concern, Ecology undertook a limited study in order to help answer a central question:

- Are the budgeting and cost control practices of USDOE-RL and its contractors adequate to ensure the development of valid cost estimates and efficient use of funds?

To accomplish this task, Ecology evaluated USDOE-RL's review procedures, and three Hanford projects: two Resource Conservation and Recovery Act (RCRA) waste storage facilities, and a RCRA storage facility undergoing closure.

Ecology did not intend, and does not consider, this study to be either an exhaustive evaluation of these projects or of USDOE's ability to project costs. Rather it is a preliminary attempt to understand the budgetary and management processes employed at the Hanford Site with respect to the TPA. Evaluating cost estimates and how they are derived is an extremely complicated endeavor. This is particularly true at the Hanford Reservation in light of the relationship and responsibilities between USDOE and its four main Contractors--Westinghouse Hanford, Kaiser Engineers, Pacific Northwest Laboratories, and the Hanford Environmental Health Foundation.

Ecology undertook this task by focusing on three areas: 1) who makes budgetary decisions and how are budget estimates prepared; 2) what costs have been incurred or are estimated to be incurred for the selected projects or activities; and 3) how do these costs compare to those costs associated with similar activities at other facilities or in the private sector.

II. SUMMARY OF FINDINGS

The short answer to the central question of this study, "Are the budgeting and cost control practices of USDOE-RL and its contractors adequate to ensure the development of valid cost estimates and efficient use of funds?" is no. The study team emphasizes that this answer reflects a lack of confidence in USDOE's cost estimates and review procedures, and is not the result of an unequivocal determination of what USDOE's costs should be. This section summarizes the study team's reasons for its central conclusion. Section III, USDOE Review of Documents, and Section IV, the Analyses of Selected Projects, provide the details.

A. PRIVATE SECTOR COST COMPARISONS

This study does not provide an independent validation of USDOE's costs, but does compare USDOE's project costs, where possible, with similar costs in the private sector. The facility renovation costs at the 305-B facility, and the construction costs of the 616 facility, for example, conform to construction industry standards for renovation and new construction, respectively. The study team was unable to develop comparisons for operating costs, but did develop private sector cost estimates for the preparation of the 2727-S closure plan, and for the permit applications for 305-B and 616. Westinghouse Hanford Company's (WHC) closure plan costs for the 2727-S facility, and Pacific Northwest Laboratory's (PNL) permit application costs for the 305-B facility both fall within the parameters of the private sector estimates. WHC's permit application costs for the 616 facility, however, exceed the high end private sector estimate by $270,000 ($504,000 compared to $234,000).

B. PROBLEM AREAS

In its investigation of the selected projects, the study team finds three general problems:

(1) inadequate USDOE oversight of contractors' programmatic and budgetary decisions,

(2) excessive, and yet ineffective, internal reviews of budgets, permit applications, and closure plans by contractors, and

(3) inadequate analysis of costs and feasibility by contractors prior to decision-making.

1. Inadequate USDOE Oversight

The primary documents that serve as the basis for USDOE's approval of funding are the Activity Data Sheets (ADS). Despite the importance of these documents, however, USDOE is currently unable to provide the appropriate review, in particular, of WHC's ADS submissions. USDOE-RL management assures the study team that their ADS review is adequate, but other USDOE-RL staff cite staff shortages, the obligation to meet deadlines, and insufficient detail in the Activity Data Sheets as ongoing problems in its review process. The practical effects of these limitations are that USDOE cannot challenge WHC's cost projections, and that the original cost estimates devised by WHC Program Managers and Cost Account Managers survive the entire review process.

The ratio of contractor staff to USDOE-RL is 40:1, a relationship that reveals USDOE's disadvantage in managing projects and project costs.

Each ADS assigns a level of confidence to the cost estimates. The Activity Data Sheets for the projects selected for this study have a range of confidence levels from medium to low, based largely on the lack of historical data. Other reasons for low confidence levels are the absence of technical knowledge, the preliminary nature of some estimates, or the lack of an engineering study. The study team determined that 17 percent of the FY 91 Activity Data Sheets associated with funded TPA milestones were assigned high confidence, 33 percent were of medium confidence, and 50 percent were of low confidence. From the standpoint of total dollars required for FY 91 TPA activities, 11 percent of the FY 91 estimates had high confidence, 59 percent of the estimates were of medium confidence, and 30 percent had low confidence.

2. **Excessive and Ineffective Review**

The study team finds that the number of internal reviewers used by USDOE's contractors in the projects selected for this study is excessive, and offers the following illustrations: 10 PNL reviewers for the 305-B permit application; approximately 20 WHC reviewers for the 2727-S closure plan; and 16 WHC reviewers for the 616 permit application. USDOE also reviews these documents with the assistance of consultants. The study team notes that these reviews add time and costs to the projects, and that, in the projects analyzed by this study, the reviews included the highest management levels, and still resulted in no significant change in course.

The study team also suggests that the WHC review of costs may be ineffective, amounting to a rubber-stamp approval of project costs generated by Program Managers. This finding corresponds with USDOE's own observation in its December 1989 audit of WHC's Tri-Party Agreement management practices:

"There is no detailed senior level WHC management review of budget/schedule impacts and integration relating to TPA commitments within the fiscal year 1992 Activity Data Sheets. There is no independent validation of cost and schedule."

3. **Inadequate Analysis**

WHC decided to pursue clean closure of the 2727-S facility without benefit of either feasibility or cost studies, and PNL decided to seek a storage permit for the 305-B facility with no analysis of operating costs and without a thorough examination of the less-than-90-day storage option.

In its decisions regarding the clean closure of 2727-S (a small storage facility), WHC failed to study the technical feasibility of decontamination, and failed to examine the costs of disposal at a RCRA landfill. In addition, WHC based its 1989 budgeted closure costs for 2727-S in part on sampling cost estimates made without benefit of site characterization.

PNL based its decision to seek a RCRA permit for 305-B (a radioactive mixed waste storage facility) on three points of information--WHC's estimated increase in charges for use of the 616 facility, the unsuitability of an alternative facility (332), and a capital cost study for upgrades of 305-B. PNL did not know what the operating costs would be for 305-B as a RCRA facility, but nevertheless assumed on the basis of the plant manager's professional judgment that the costs of operating it as a short-term storage facility would be higher. The study team does not find that PNL's decisions regarding 305-B were necessarily wrong, but rather that they lacked the appropriate analytical base.

C. THE HANFORD CULTURE

The study team suggests that the problems it has identified may belong to a larger pattern, what some call the "Hanford Culture." The recent Tiger Team assessment of the Hanford site identifies as one of three root causes of Hanford's environmental, safety, and health problems that, "Management has not accomplished the necessary safety culture change." The report mentions "decades of ingrained attitudes" and suggests that the assurance that the workers are receiving the correct new message can be obtained, in part, by "greater management/supervisory oversight..."

The study team concurs with this assessment. It found no real incentive to keep costs down, nor any incentive to change any management practices, but rather a casual acceptance of business as usual. The study team recognizes that the pervasiveness of old attitudes and the collective sense of institutional history are powerful forces, and that a cultural change will not come easy.

III. USDOE REVIEW OF DOCUMENTS

The study team conducted interviews with Westinghouse Hanford Company (WHC) personnel to find out what kind of cost information WHC submits to USDOE, and to determine how WHC develops that information. The study team also interviewed USDOE-RL personnel to determine the extent of USDOE-RL's review of the cost information it receives from WHC.

A. THE ACTIVITY DATA SHEETS

The primary document that serves as the basis for USDOE's approval of funding for Tri-Party Agreement activities is the Activity Data Sheet (ADS). An ADS provides cost estimates for the activities conducted under a program. Some Activity Data Sheets are specific to projects or activities, and some are program-wide. A program-wide ADS provides no detail on individual activities within a program. (The ADS covering PNL's 305-B facility is an example of a program-wide ADS.) The level of detail in the Activity Data Sheets reflects the needs of the primary user--USDOE-Headquarters. USDOE initiated the ADS system in FY 90, and is still revising it.

1. WHC Development of Activity Data Sheets

The WHC Program Managers and Cost Account Managers begin the ADS process. These managers develop the cost estimates for their programs, and send their completed Activity Data Sheets to the next higher WHC management level--Plant Manager or Program Director--for review and approval. The WHC Program Administration group also participates in the development of Activity Data Sheets by providing the line managers with financial advice and plan coordination.

2. USDOE-RL Review

USDOE-RL management describe the ADS review process as iterative. The staffs of USDOE-RL and WHC exchange information prior to the formal submission of the Activity Data Sheets, and follow the submission with a series of reviews. In what one manager describes as a "rolling wave" process, USDOE updates their five-year plan annually, and examines the budgets for each year in increasing detail as that year approaches, revising Activity Data Sheets in light of new information or changing conditions.

USDOE assigns each ADS to one of four categories--Waste Management, Environmental Restoration, Technology Development, and Corrective Activities--and distributes the Activity Data Sheets to the appropriate USDOE-RL division for review. The USDOE-RL Monitors--those staff persons responsible for ADS reviews--consider the following elements in their review of these documents:

--justification for the proposed activities

--scoping of the work to be accomplished

--priority assigned to the ADS, and

--whether the activity is TPA-related.

These elements, however, do not constitute a uniform review procedure, and the Monitors develop their own approaches to the task. The Monitors typically ask the WHC staff to supply additional documentation in support of ADS budgets, particularly for large programs. The Monitors may review cost components such as labor rates and other expenses used in the ADS budgets. According to one Monitor, most of the ADS changes that result from USDOE's review are not budgetary adjustments but rather changes in the assignment of priority.

In contrast to management's assurances of the adequacy of the ADS review process, some USDOE-RL personnel (including management) cite a shortage of staff, combined with the obligations to meet deadlines, as problems. The range and number of duties of the Monitors limit the oversight they can provide. In the most recent ADS review, for example, one Monitor held responsibility for the program cost review of approximately 325 Activity Data Sheets, and had to perform this function in a two-week period. The overall ratio of contractor staff to USDOE-RL staff is 40:1.

Each ADS includes an assignment of a high, medium, or low confidence level to the ADS's cost estimates. A rationale for the assigned confidence level explains the basis for the cost estimate--historical costs, model, or whatever technique was used--and identifies any data deficiencies such as the absence of technical knowledge or the lack of an engineering study. Of the Activity Data Sheets with funded TPA milestones for FY 91, 17 percent were assigned high confidence, 33 percent were of medium confidence, and 50 percent were of low confidence. From a total dollar standpoint, 11 percent of the FY 91 estimates for TPA milestones had high confidence, 59 percent of the estimates were of medium confidence, and 30 percent had low confidence.

B. OTHER USDOE-RL REVIEWS

1. Review of Capital Projects

The development of a capital project follows a specific procedure in which USDOE-RL reviews three documents. The process begins with an engineering study. The next step is a functional criteria report, and the last step is a conceptual design report. The conceptual design report provides detailed costs estimates. USDOE-RL reviews and approves these three documents.

In the area of capital project reviews, USDOE-RL staff report none of the misgivings apparent in the ADS reviews. The contractors provide information sufficiently detailed to permit a cost evaluation, and USDOE-RL seems to devote enough staff and sufficient time to conduct adequate reviews of capital projects.

2. Mid-Year Reviews

USDOE-RL conducts mid-year program reviews which USDOE-RL staff describe as an opportunity for the contractors to reevaluate priorities and to get approval for base program changes in response to new developments. USDOE-RL staff report that the subjects of these mid-year reviews are costs, schedules, and technical performance.

C. CONCLUSIONS

The study team finds an important discrepancy between the perceptions of management and staff regarding the review of Activity Data Sheets. While management asserts that the ADS review process is adequate, some of the Monitors report (as do some management personnel) that staff shortages and tight deadlines cause problems. The example of one Monitor responsible for the review of approximately 325 Activity Data Sheets in a two-week period is indicative of the difficulty facing a Monitor attempting to perform a thorough review.

The confidence levels assigned to the Activity Data Sheets supports the study team's lack of confidence in USDOE's budget estimates: 50 percent of the total number of specific TPA milestone Activity Data Sheets for FY 91 have a low confidence level; and 89 percent of all dollars assigned to specific milestones for FY 91 are assigned medium or low confidence levels.

The study team finds that USDOE-RL's review of capital projects is much stronger than its ADS review. The three-step process provides the information and time necessary to perform an adequate review, and the study team notes that USDOE's renovation and construction costs conform to construction industry standards.

IV. ANALYSES OF SELECTED PROJECTS

The study team's most important source of information was the set of personal interviews the team conducted with those individuals responsible for the operations of selected projects. The study team also interviewed the individuals who prepared materials upon which managers based their project decisions. Technical reports and documents provided by USDOE-RL and its contractors supplemented the information gathered in these interviews. The Appendix provides a detailed listing of references. The project team then evaluated the available information, and, where possible, compared the selected projects with similar projects both within and outside of Hanford.

The following sections of this report present the analyses of selected projects on a project-by-project basis. Each analysis follows the same format: (1) a description of the project facility or activity; (2) a description of the USDOE-RL project costs; (3) the study team's evaluation of USDOE-RL's project costs; and (4) the study team's conclusions.

The study team prepared private sector cost estimates for the preparation of three documents relevant to the selected projects--a closure plan for the 2727-S storage facility, and RCRA permit applications for the 616 and 305-B storage facilities. These cost estimates assume that a medium to large (500-3000 staff) engineering firm experienced in Washington State RCRA permitting prepared the documents for a private client. The estimates reflect the preparation of two drafts and one final document in each case to account for the necessary responses to Notices of Deficiency. The Appendix includes a detailed description of the methodology used for this analysis.

A. THE 305-B RMW STORAGE FACILITY

1. Facility History and Description

The 305-B Storage Facility is a two-story, 7,000-square-foot building constructed of steel and concrete. Built in 1978, 305-B was originally a Pacific Northwest Laboratory (PNL) engineering research and development facility. In the mid-1980s PNL considered the building underutilized, and later used it for a limited period as a short-term storage area. PNL then upgraded the facility for use as a long-term storage facility. In March of 1989, 305-B began service for hazardous and radioactive mixed waste storage, and PNL is currently in the process of applying for a RCRA storage permit.

2. Description of USDOE's Project Costs

PNL's decision to use 305-B as a RCRA storage facility was a result of three coinciding circumstances:

--the inadequacy of PNL's 332 building for waste storage,

--a large increase in WHC's charges to PNL for long-term storage at WHC's 616 storage facility, and

--the availability of 305-B.

PNL had used its 332 building as a short-term waste storage facility, and by the late 1980s the facility could no longer meet PNL's operational requirements, in large part because its 400-square-foot capacity was too small. In addition, short-term storage entailed certain logistical and economic inefficiencies because PNL had to package, manifest, and ship small and less-than-full containers to comply with the maximum 90-day storage requirement.

PNL could have continued to use 332 for short-term storage, and could have continued to send its wastes for long-term storage to WHC's 616 facility, but in 1988, when WHC announced an increase in storage charges from the current $80,000/year to an expected $800,000/year, PNL decided to explore the option of getting its own permitted facility for long-term storage. Prior to 1988, WHC had not prorated its long-term storage costs to all of the generators that used the 616 facility, and WHC's announcement of this large price increase was actually the inception of WHC's new storage cost policy to require each generator to pay its appropriate share of the storage costs. WHC later revised its estimated increase to $455,600-729,000/year, depending on the amount of waste received at the facility, and on the final per-container rate.

The availability of 305-B provided PNL with another storage facility option, one with a larger capacity (7,000 square feet).

By submitting Part A applications for both 332 and 305-B, PNL preserved the options of using either or both facilities for long-term waste storage. PNL subsequently decided, however, that the 332 building was undesirable for waste storage operations. The building was too small, and the costs of the upgrades--including bringing water to the facility--were too high. PNL estimated the facility improvement costs along with the permit preparation costs for 332 to be roughly $400,000-500,000.

The 305-B facility, on the other hand, required far less extensive modifications, and was large enough for PNL's purposes. PNL's Engineering Department prepared a cost estimate of the capital improvements necessary to meet interim status, and concluded that the modifications would cost $140,000-150,000. The plant manager, in light of 305-B's greater capacity and lower capital costs, decided to seek a RCRA permit for 305-B only.

a. Operating Costs

PNL did not conduct an economic analysis of the costs of operating 305-B as a RCRA storage facility in its decision to seek a permit for the building, but, rather, tacitly assumed that the operating costs would be lower than the combination of WHC's charges and PNL's costs of operating a short-term storage facility. In fact, PNL asserts that just the operating costs of a short-term storage facility would exceed the operating costs of 305-B as a RCRA storage facility because of the inherent inefficiencies of short-term storage operations.

The USDOE budget does not break out the operating costs for the 305-B facility, but includes those costs within PNL's waste management overhead account. The FY 89 budget for this account was $1,555,000; the FY 90 budget, $1,781,000. USDOE's Activity Data Sheet (ADS) 8002 estimates that $2,297,000 is required to fund all activities within this account for FY 91. The 305-B operating costs are presumably contained somewhere in these ADS figures.

PNL reports that the actual annual operating costs for 305-B for FY 89 were $673,000. Table 1 shows the breakdown.

Table 1

305-B COSTS - FY 89 and FY 90

Category	FY 89 Costs	FY 90 Costs (through mid-August
Personnel Labor	$145,000	170,000
Materials and Supplies	45,000	55,000
Training	3,000	5,000
SUBTOTAL	193,000	230,000
Disposal Fees	480,000	192,000
TOTAL	$673,000	422,000

For FY 89 PNL was still paying waste storage fees to WHC. In FY 90, however, PNL has used 305-B for its waste storage, and has paid no fees to WHC. PNL's FY 90 expenditures for 305-B, through mid-August 1990, are $422,000.

b. Permit Preparation Costs

PNL considered two options for the preparation of the 305-B permit application--preparing it internally with the assistance of an outside consultant, or having WHC prepare it under contract to PNL.

PNL based its estimate of the cost of preparing the application internally on the contents of a permit for a similar waste storage facility in Washington State. The cost estimate for this option was approximately $200,000. WHC, on the other hand, initially estimated the application preparation costs to be $600,000, basing their estimate on the permit preparation costs for the Grout Facility, a much more complicated application. This estimate was part of a larger scoping exercise to provide rough cost estimates for TPA-related work at 53 sites at Hanford. The 305-B plant manager selected the internal option on the basis of these costs. WHC, in a refinement of its original scoping exercise, later revised its estimate to $200,000-400,000.

Table 2 shows the PNL and USDOE reviewers of the 305-B permit application.

Table 2

305-B PERMIT REVIEWERS

Reviewer Title	Function
ICF (a PNL Consultant)	Assisted PNL in preparation of Part B permit application
305-B Operations Supervisor	Co-author of permit
PNL Senior Compliance Engineer	Peer review/technical
Editor	Typing/grammar check
Section Manager, Laboratory Safety Department	Technical review, one over one review
Department Manager, Laboratory Safety Department	Management review
Director, Facilities and Operations	Management review
Legal Staff	Legal review
USDOE Staff and Consultants	Technical and legal reviews
Director, PNL	Approval/certification
Manager, USDOE	Approval/certification

The plant manager made all of the decisions regarding the use of 305-B with senior PNL management review. USDOE personnel also reviewed the decisions.

3. Evaluation of USDOE's Project Costs

a. PNL's Basic Options

PNL had two options related to its use of 305-B:

Option 1
Seek a RCRA permit for 332, 305-B, or both. Prepare the permit application.

The costs associated with Option 1 are as follows:

--capital costs of facility renovation
--permit preparation costs
--operating costs
--post-storage disposal costs.

Option 2
Seek no RCRA permit. Operate 332, 305-B, or both as short-term storage facilities. Ship wastes to WHC's 616 facility or to another RCRA facility.

The costs associated with Option 2 are as follows:

--operating costs for a short-term storage facility
--storage costs (WHC's 616 or other facility)
--post-storage disposal costs

PNL's decision to seek a RCRA permit for 305-B as opposed to 332 makes sense on a logistical and waste management basis--the 332 building is too small for PNL's long-term storage needs. PNL estimated that the necessary upgrades of 332, along with the permit preparation, would have cost $400,000-500,000. PNL did not conduct a thorough cost analysis of this option, but given the small size of the facility, such an analysis was not really necessary.

The 7,000-square-foot floor area of 305-B (compared to 400 square feet for 332) made the 305-B option more attractive from the logistical point of view, and PNL investigated the facility improvement costs of this option more thoroughly. The Engineering Department estimated the costs of the improvements necessary to bring 305-B into RCRA compliance at $140,000-150,000, an estimate comparable to private sector renovation costs and construction industry standards. The 305-B plant manager reports that the actual costs of the facility improvements were $100,000-110,000, well under the estimate.

While these facility improvement cost estimates were accurate, however, the assessment of the facility improvements necessary to bring 305-B into RCRA compliance may not have been. In a Notice of Deficiency (NOD) dated April 26, 1990, Ecology identifies several plant shortcomings that may entail additional facility improvement expense to correct. The issue turns on a difference of professional opinion on what constitutes secondary containment.

The decision to seek a RCRA permit as opposed to seeking no permit is more difficult to assess because PNL did not develop any cost comparisons. If PNL had opted to seek no RCRA permit, it would have had to pay WHC's charges for long-term storage, and would have had to operate either 332 or 305-B as a short-term storage facility. PNL's tacit assumption that its operating costs for 305-B as a RCRA facility would fall below the combination of WHC's charges to PNL for storage at 616 and PNL's costs of operating its own short-term storage facility remains unconfirmed by PNL's experience. PNL asserts that operating a short-term storage facility would cost more than operating 305-B under a RCRA long-term storage permit because of the inherent inefficiencies in short-term storage operations. The study team finds no information to confirm or refute this claim.

The study team acknowledges that one of the inherent problems in less-than-90-day storage falls beyond the control of the storage facility manager--if the generators do not send their wastes to the storage facility in a timely manner, then the storage facility may have insufficient time to arrange suitable treatment or disposal and still beat the 90-day clock. In PNL's situation, the 305-B manager could not enforce timely shipment by the generators. PNL senior management, however, could have insisted on timely shipment, thereby insuring that PNL could manage its wastes on a less-than-90-day basis in a manner similar to other waste generators in the state.

The study team notes that the 305-B operating costs for FY 90 are $422,000 through mid-August, an amount that projects to approximately $480,000 for the full year. This total compares favorably with the FY 89 total of $673,000. This finding suggests that PNL has improved its situation from the previous year, but not that it has necessarily found the best alternative for its waste management.

A re-examination of PNL's two options reveals that PNL's cost information and analysis do not fully support its decision-making. At the time the plant manager decided to seek a permit for 305-B as opposed to 332, he had a rough estimate of the renovation costs for 332. This information, combined with the physical limitations of 332, was sufficient to remove 332 from further consideration. The plant manager subsequently got an Engineering Department capital cost estimate for the renovation of 305-B. He also knew WHC's estimated disposal costs for the use of 616.

What PNL's plant manager did <u>not</u> know were the operating costs for 305-B either as a RCRA facility or as a short-term storage facility. In the plant manager's professional judgment, this analysis was unnecessary because the difficulties of operating on a less-than-90-day storage basis made that option untenable. Given the lack of cooperation by the generators, the study team would concur with this decision. The study team does not, however, accept this condition as a given because PNL management could enforce a waste management policy that conforms to the 90-day limit. The study team recognizes that this broader view exceeds the responsibilities of the plant manager, and holds PNL senior management and USDOE accountable for the failure to consider this option.

A thorough analysis would consider the following elements for each of the two options (RCRA vs. short-term storage): the operating costs; the permit preparation costs; the estimated useful life of the facility; the salvage value; the ultimate closure costs; and other benefits both quantifiable and not. Such an analysis would also account for cost and benefits occurring in different time periods, and would establish present values as a basis for comparisons. In the absence of such an analysis, PNL and USDOE must rely on their unverified assumptions and assertions.

The Department of Energy's Activity Data Sheets (ADS) show only composite cost information, and an evaluation of a specific project's planned versus actual costs based on the ADS is impossible.

b. Permit Preparation Costs

PNL based its decision to prepare the permit application internally on a straightforward comparison of the two alternatives. PNL could do the work itself with the assistance of a consulting firm for $200,000. WHC's original estimate of the permit application costs was $600,000, later revised to $200,000-400,000, but too late for PNL to consider.

The actual permit application costs for FY 89 were $102,000; the estimated costs for FY 90 are approximately $90,000. If the FY 90 estimates prove to be accurate, the total cost for the permit application will be $192,000, or $8,000 under the original estimate. That the actual costs fall within the estimated costs does not, however, confirm the reasonableness of the estimate. The study team questions the necessity of the 11 separate reviews of the permit application, and notes that each review adds to the cost of the permit preparation.

PNL's permit preparation costs nevertheless compare well with private sector costs as developed by the study team. (See the Appendix for methodology details). The private sector estimated costs range from a low end of $153,000 to a high end of $246,000. The study team notes that PNL's costs fall within this range.

WHC asserts that PNL's permit preparation costs for 305-B should reflect PNL's use of boilerplate developed by WHC for its 616 facility permit application. The study team disagrees. It is common practice for permit preparers to avail themselves of EPA guidance documents and previously-submitted permit applications. If PNL had not used WHC's material, it could have used available substitutes.

4. Conclusions

The study team concludes that the cost information available at the time PNL's plant manager made his decisions was not adequate to support all of those decisions. PNL did have sufficient information to eliminate 332 from further consideration, but based its decision to seek a RCRA permit for 305-B on unverified assumptions that remain unconfirmed by experience. From the plant manager's perspective, the RCRA storage decision made sense, but from the broader management point of view, the analysis does not support the decision. The study team does not find that the 305-B decisions were necessarily wrong, and notes the reduction in operating costs from FY 89 to FY 90. The study team does, however, find that the analytical base was inadequate and that PNL senior management and USDOE failed to examine thoroughly the less-than-90-day storage option.

B. 2727-S NONRADIOACTIVE DANGEROUS WASTE STORAGE FACILITY

1. Facility History and Description

The 2727-S Waste Storage Facility is an 800 square-foot temporary steel building on a 6,200-square-foot concrete pad. It was built in the early 1960s in the 200 West Area of the Hanford Reservation, and was used by Rockwell Hanford Operations for the container storage of hazardous waste. Storage operations began in March 1983, with wastes stored not only in the building, but also across the entire pad and on the surrounding soils. In December of 1986, Rockwell closed the facility because it did not have the capacity to handle the expected volume of waste, and because it would have required significant retrofitting to meet RCRA standards. Westinghouse Hanford Company (WHC) assumed responsibility for 2727-S in July of 1987.

2. Description of USDOE's Project Costs

USDOE owns the 2727-S nonradioactive dangerous waste storage facility and co-operates it with WHC. In interviews with the study team, WHC personnel frequently referred to 2727-S as an "orphan child" because funding and management responsibility for the facility was uncertain in recent years. Prior to July 1, 1987, Rockwell Hanford Operations managed the facility, and in 1985 Rockwell decided to close 2727-S. USDOE later changed the Hanford operating contractor to WHC, and WHC is now conducting the closure of 2727-S.

WHC identified two options for the clean closure of 2727-S:

(1) salvage the building through chemical assessment and decontamination, and

(2) assume the building is contaminated and dispose of it as dangerous waste at a RCRA landfill.

WHC summarily rejected the second option as too costly. The disposal of the facility under this option would have entailed demolition of the building and disposal at a RCRA landfill of contaminated building materials, concrete, and soil in the 2727-S area.

Having selected the salvaging option, WHC then considered two alternatives within that option:

(1) decontaminate the building and leave it standing, or

(2) decontaminate the building, demolish it, and send it to a solid waste landfill.

The costs of disposal at a solid waste landfill are considerably less than those at a RCRA landfill because of the stricter requirements for disposal of dangerous waste. In addition, disposal of dangerous waste at a RCRA facility entails liability for any adverse consequences resulting from such disposal, liability for cleanup costs, for example, in the event the RCRA site becomes a superfund site.

WHC Operations requested that the 2727-S building be left standing because it might be needed in the future. Consequently, WHC decided to decontaminate the building and clean up the area to background levels. WHC further decided, as a contingency, that if they could not achieve background levels, they would demolish the building and dispose of it, along with any contaminated soil, at a RCRA landfill.

More recently, WHC decided to remove all materials from the interior of the 2727-S building, and to dispose of these materials--insulation, wiring, etc.--at a RCRA landfill. After removing these materials, WHC plans to attempt the decontamination of the metal walls and ceiling--a much simpler operation than the decontamination of all the other materials. WHC currently plans to use the building--assuming successful decontamiantion--for equipment storage. Demolition and disposal at a RCRA landfill is still the last resort.

Rockwell hired a consultant to prepare the first closure plan (as part of the operating permit). Since the completion of that draft (in 1985), WHC and other consultants have prepared several revised plans. WHC's internal review process includes approximately 20 reviewers and up to 30 signatures before a plan goes to USDOE for their review. Each revision has undergone this same extensive review. WHC submitted its most recent revision to Ecology in February of 1989, and Ecology responded to that revision with a Notice of Deficiency (NOD) in June of 1989. In March of 1990 WHC submitted its completed response to Ecology's NOD, and Ecology is currently reviewing this document.

In its latest cost revision submitted to the study team, WHC projects its total costs from 1987 through 1990 for the closure of 2727-S to be $920,000. WHC and USDOE did not provide the study team with costs incurred before 1987 for the development of the closure plan.

3. Evaluation of USDOE's Project Costs

WHC's experience with the closure of 2727-S is a good example of the dilemma that typifies clean closure decisions. The easier course to follow is to assume contamination and to dispose of all materials at a RCRA landfill. The problems with this course, however, are that RCRA disposal is more expensive than solid waste disposal, and entails liability for any adverse consequences resulting from such disposal.

The other course is to attempt decontamination, but the problem with this course is its uncertainty. Facility managers need samples for analysis to determine the extent and type of contamination, and then need further samples to confirm the success of decontamination efforts. The actual decontamination process entails material, labor, and waste disposal costs, and both the sampling and decontamination processes can vary considerably in their extensiveness according to the level and type of contamination. Choosing the decontamination course carries with it the inherent economic risk that facility management may find out that decontamination is infeasible after spending significant sums in that effort. The only recourse is the RCRA disposal option.

In the actual case of WHC's decisions regarding the closure of 2727-S, the disposal of the building materials and soil at a RCRA landfill was the option WHC initially rejected as too costly, and yet it is the contingency option if decontamination procedures fail to achieve background levels. In other words, after the removal of interior materials, WHC plans to attempt the decontamination of 2727-S (at considerable cost), and if that effort fails, then WHC will fall back to the option it originally rejected as too costly--the dilemma in action.

The real problem with WHC's approach is not that they face a dilemma, but that they are proceeding with their plan without benefit of any study of either the feasibility of decontamination or the cost of the RCRA landfill option. The recent closure plan revision that calls for the RCRA disposal of interior materials does make the decontamination effort simpler, but WHC has not calculated the costs. WHC also failed to examine another important element in the decision-making process--the WHC Operations request to leave 2727-S standing. That request seems to have guided WHC into their preferred alternative, but no one ever asked what it would cost to build a similar replacement structure. After all, 2727-S is an 800-square-foot temporary steel building on a concrete pad. The costs of decontaminating to background levels may be higher than the combined costs of demolition, disposal, and building a replacement.

Table 3 displays WHC's 1987-1990 costs for its closure of 2727-S. This information comes from the first documents submitted by WHC to the study team. Of the $1,220,000 total cost, $450,000 are the closure plan preparation costs ($150,000 spent between 1987 and 1989, and a projected $300,000 for 1990).

Table 3

2727-S HISTORICAL AND PROJECTED COSTS

Cost Category		HISTORICAL ($)	PROJECTED ($)	TOTAL
Closure Plan Preparation:	1987-1989 1990 Only	150,000	300,000	450,000
Sampling:	Labor Analysis	- -	90,000 175,000	265,000
Decontamination/ Decommissioning:	Labor Disposal	- -	210,000 125,000	335,000
Characterization:	Materials Labor	- -	20,000 150,000	170,000
	TOTALS	150,000	1,070,000	1,220,000

Upon reviewing these Table 3 figures in a draft of this study, however, WHC provided the following revisions: historical costs of $129,500, and projected costs of $80,000. In a subsequent telephone call, however, WHC provided the following revised revisions: historical costs of $100,000, 1990 costs of $15,000, and 1991 projected costs of $35,000. The total closure plan preparation costs reported by WHC to the study team have therefore fallen from $450,000 to $209,500 to $150,000. Based on this last figure, the total closure plan costs for 2727-S are $920,000.

The plan preparation costs include the costs of WHC's internal review. The necessity and effectiveness of the approximately 20 reviewers is questionable. WHC estimates that the total costs of review actually charged to the 2727-S closure plan are approximately $10,000.

The study team estimates the private sector costs for a closure plan for 2727-S in a range from a low end of $135,000 to a high end of $210,000. The last costs WHC submitted to the study team for the closure plan preparation are $150,000, within the private sector cost range.

The 1989 Cost Account Plan (CAP) shows a total of $683,700 in sampling and decontamination costs for 2727-S. Table 4 provides the details.

Table 4

2727-S BUDGETED COSTS FOR 1989
(from 1989 Cost Account Plan)

Sampling Costs (000)	
Assist in Obtaining Samples 2727-S	19.8
Provide Heavy Equipment and Teamster Support	5.5
Provide Electrician Support	2.1
Provide Crane & Rigging Support to Sampling	1.7
Provide RPT to Sampling	1.2
Provide QA Support to Sampling	1.3
Engineering Support/Regulatory Permitting	6.6
Take Characterization Samples and Analyze, Prepare Necessary Documentation for Performing Characterization	158.6
Provide Coordinated Support for Sampling	5.3
Provide Supervisory Support for Sampling	9.4
TOTAL SAMPLING COSTS	211.5
Decontamination Costs	
Decontaminate, Demolish and Package building, Slab Soils, Decontaminate Equipment and Restore Site: Issue Project Summary Report	95.5
Provide Support to the Closure of 2727-S	42.5
Provide Engineering Support to the Closure of 2727-S Including Certification Sampling and Analysis: Issue Decommissioning Report	51.3
Waste Disposal through 616 Facility	120.0
Bulk Waste Disposal by Northwest EnviroService	30.0
TOTAL DECOMMISSIONING COSTS	339.3
SUBTOTAL SAMPLING AND DECOMMISSIONING COSTS	550.8
GA/CSP	132.8
TOTAL	683.6
Closure Plan Preparation Costs	
Support 2727-S Closure Plan Revision and Response	63.8
IRM Support	45.0
Support 2727-S Closure Plan Revision and NOD Response	9.7
SUBTOTAL	118.5
GA/CSP	30.2
TOTAL CLOSURE PLAN COSTS	148.7
TOTAL 2727 COSTS	832.3

A WHC Cost Account Manager informed the study team that these 1989 CAP costs (a total of $832,300) were budgeted but never spent. The WHC manager responsible for 2727-S informed the study team that the 1989 2727-S budgeted costs were based in part on sampling cost estimates made without benefit of a characterization. These unspent authorized funds were subsequently applied to other projects as a part of normal funds management with the approval of USDOE-RL.

4. Conclusions

The study team concludes that WHC's approach to the closure of 2727-S has been haphazard at best and has compounded the difficulty of an inherently difficult decision. WHC failed to study the technical feasibility of decontamination, and failed to examine the costs of disposal at a RCRA landfill. In addition, a vague request by WHC Operations to preserve 2727-S for some future use influenced the decision to decontaminate the building and leave it standing. WHC proceeded with their plan with a limited understanding of the contamination at the site, and consequently based their original cost estimates on conjecture rather than on any analytical grounds. The study team questions the credibility of the cost data provided by USDOE and WHC, and notes that the successive revisions of the closure plan preparation costs erode confidence in the figures.

C. 616 HAZARDOUS WASTE STORAGE FACILITY

1. **Facility History and Description**

The 616 Storage Facility is a 20-foot high, one-story concrete building with 7,700 square feet of floor area. The building has a separate external ventilation system, a secondary waste containment system (including separate collection drainage ditches), and an office area. Rockwell designed 616 to be among the most modern of RCRA facilities, and built it in 10 months. Rockwell's original intent was that 616 would serve as a temporary storage area for all on-site wastes, and it functioned in that capacity until 1989 when PNL started using their own waste storage facility. The 616 facility now serves as a storage area, under the management of WHC, for all nonradioactive dangerous wastes generated at the Hanford Reservation except for those that PNL produces.

2. Description of USDOE's Project Costs

a. Capital Costs

Rockwell based its decision to build the 616 facility on an engineering study done by the J.A. Jones Company in 1984. The Jones study considered four alternatives:

(1) build 616;

(2) continue use of 2727-S;

(3) require each waste-generating facility to seek a permit as a TSD; and

(4) use another facility.

The Jones study rejected the continued use of 2727-S (alternative 2) on the basis that the facility did not comply with RCRA regulations, and rejected the alternative of requiring each waste-generating facility to seek its own permit (alternative 3) as neither viable nor cost effective. The study also eliminated the alternative of using another building (alternative 4) when researchers could not locate a suitable, available facility. After reviewing the alternatives, the Jones study recommended the construction of a new facility--616.

USDOE-RL Operations Office Projects reviewed and approved the decision, and Rockwell built the 616 facility in 10 months at a cost $926,000. Designed to meet RCRA requirements, the 616 facility is among the most modern of hazardous waste facilities.

b. Permit Costs

WHC's costs for obtaining a RCRA permit for the 616 facility are $429,000 through 1990. Table 5 provides a breakdown.

Table 5

COST FOR 616 PERMIT PREPARATION
(In 000 Dollars)

Category		1989 (FY)	1990 (FY)	1989 + 1990 (FY)
Personnel (Technical)		183	100	283
Personnel (Support Services)		46	21	67
Materials		50	29	79
Paper, notebooks, dividers	13			
Printing, graphics, technical editing	20			
Computer	10			
G&A/CSP	7			
TOTALS		279	150	429

The personnel costs add up to $350,000 ($283,000 for technical plus $67,000 for support services). Eighteen different administrative units of WHC and USDOE review each revision of the permit application. Table 6 provides the details of the review process.

Table 6

616 PERMIT REVIEWERS

Reviewer		Function
1.	616 Supervisor	Assures completeness and accuracy of operational aspects
2.	616 Manager	Assures completeness and accuracy of operational aspects
3.	Solid Waste Process Cognizant Engineers	Authors of general description, waste characteristics, and process information permit application chapters: assures accuracy and completeness of these chapters
4.	Environmental Compliance Officer	Assures waste management facilities comply with applicable regulations
5.	616 Program Manager	Assures programmatic and budgetary aspects of 616 are met
6.	Lead Permitting Engineer	Responsible for permit preparation, coordination, and integration: assures accuracy and completeness of entire permit
7.	RCRA Permits Section Management	Assigned management responsibility to assure permit applications are accurate and complete
8.	Environmental Preparedness Coordinator	Assures contingency plan information requirements are met and that such information is accurate and complete
9.	Closure Plan Author	Assures completeness and accuracy of closure plan
10.	Regulatory Assessment Cognizant Engineer	Assures that all applicable regulatory requirements are addressed by the permit application
11.	Controller	Reviews estimate of permit application implementation costs
12.	Legal Counsel	Conducts legal reviews
13.	Quality Assurance Engineer	Performs a quality assurance review of the permit application
14.	President, WHC	Certification of permit application as co-operator
15.	USDOE Staff & Consultants	Conducts technical, regulatory, and legal reviews
16.	Technical Editing	Editing check
17.	Designated Derivative Classifiers	Conduct patent and classification review necessary for public release of permit application
18.	Manager, USDOE	Certification of permit application as owner/co-owner

WHC estimates the total cost of the reviews charged to the 616 permit preparation to be approximately $15,000.

WHC projects an additional $75,000 in permit preparation costs for FY 91. If this projection is accurate, the total costs for the 616 permit preparation will be $504,000.

c. Operating Costs

The 616 facility operates on a break-even basis at a cost of $1,629,000 for FY 90. Table 7 provides the details of the 616 budget. WHC sets the charges to the generators so that the cost of operations are fully recovered, but no more. WHC sets a certain rate for the first six months of a year based on an assumed volume of waste, and then adjusts the rates in mid-year based on the actual volume to date. For FY 90, the adjusted rate is $700 per container, retroactive to the beginning of the year.

Table 7

616 COSTS - 1990

Operations		Engineering	
Category	**Cost (000)**	**Category**	**Cost (000)**
Solid Waste Operator	323.7	Planning, Coordination, Section Support	250.6
Training by Solid Waste Operations by Defense Waste Technology	43.1 31.0	Perform Waste Package Inspections by WHC Traffic	73.9
Clerical Support	13.4	Perform Waste Disposal Analysis	167.7
Work Order Support	35.0	Maintain Database	117.4
Materials Work Orders	17.0	Provide Support to Maintain Database	89.3
Planning/Scheduling	52.6	Assist Generators/ Respond to Special Requests	42.8
Teamster Support	10.8	TSD Support	183.3
Janitor Support	5.3	Compliance Verification	41.0
Ventilation/Balance Support	1.2		
Maintenance	39.4		
Plant Engineering Support	18.5		
Fire System Maintenance	26.5		
QA/QC/QE Support	5.5		
616 Building Electrical Maintenance	25.0		
616 Building Electricity	15.0		
TOTAL	663.0	TOTAL	966.0
Total Operation Cost of 616 Facility = $1,629,000			

The Table 7 costs do not include 616's G & A costs, which are not passed on to the generators, nor do they include off-site treatment and disposal costs, for which the generators are billed separately. The 616 facility manager reports that 616 sends all its wastes to a full-service Treatment, Storage, and Disposal facility (TSD) that treats all the waste before disposing of it. These treatment (and disposal) costs vary from $15 to $240 per container. The generators pay these treatment and disposal costs in addition to the 616 storage costs.

The 616 operating costs include annual training costs of

$74,100 for 616 personnel. The 616 facility averages 300 training hours per year per employee, and, on average, 25 percent of the work force is in training at any given time.

The FY 89 operating costs for 616 were $1,150,000. During calendar year 1989, the 616 facility took in 1336 containers from the generators. As of July 31, 1990, the 616 facility has taken in 1791 containers in FY 90.

3. **Evaluation of USDOE's Project Costs**

a. Capital Costs

Rockwell based its decision to build 616 on an engineering study that considered four alternatives and recommended the construction of the new facility. USDOE reviewed and approved this recommendation. The construction costs of $926,000 translate to a cost of $120 per square foot, a reasonable rate that compares well with private sector construction standards.

b. Permit Costs

The information that WHC provided to the study team did not include a breakdown of the review costs for the permit application, and the study team cannot determine the extent to which WHC's extensive internal reviews contributed to the overall permit application costs. The study team does, however, question the need for such extensive reviews, and notes that these reviews add to the permit costs.

In a comparison with the study team's private sector estimates of the costs for preparing a permit application for 616, the study team finds that WHC's costs of $504,000 fall far outside the private sector range. The estimated costs for private sector preparation of a permit application range from a low of $150,000 to a high of $234,000. Even the high end estimate is $270,000 less than WHC's costs.

c. Operating Costs

The operation of 616 on a zero profit basis sounds good in theory because it gives WHC no incentive to raise prices. On the other hand, it provides no incentive to keep costs down.

A comparison of the per-container costs for storage at 616 and the off-site treatment and disposal costs reveals a significant disparity. For FY 90, 616 charges its generators $700/container for storage, regardless of container size. The ultimate off-site treatment and disposal costs, on the other hand, range from $15 to $240 per container, depending on the waste.

These storage charges seem to be high enough to warrant a re-evaluation of USDOE's basic storage strategy, and, in fact, USDOE-RL recently initiated a study to evaluate the efficiency of the Hanford hazardous waste storage, transportation, and off-site disposal program. This study will consider regulatory compliance issues and risk mitigation in addition to cost-effectiveness. The USDOE-RL staff person responsible for this study does not expect the results to change the basic mission of either the 616 or 305-B facility. The study may, however, lead to more efficient operations.

WHC's Financial Analyst for their Solid Waste Program suggests that there are inequities in WHC's billing system to the generators because the engineering costs in 616's operating budget are too high for the services actually provided at 616. He has proposed that the bulk of the engineering costs be moved to WHC's G & A account so that generators would not have to bear these costs. Such an adjustment would reduce 616's costs considerably. The engineering costs represent 57 percent of 616's FY 90 budget; operations costs, 43 percent. The study team calculates that if all the engineering costs were removed from 616's budget, the per-container storage costs would drop to $301 (43 percent of $700/container). Even this reduced cost, however, would exceed the treatment and disposal costs.

In some respects, the evaluation of the 616 operating costs is an exercise in cost accounting. The engineering costs currently shown in the 616 budget may belong <u>somewhere</u> in WHC's Hazardous Waste Program, but the 616 budget should include only those engineering services in direct assistance to the 616 facility. The exact costs of engineering services attributable to the operation of 616 is a matter of discretion and cost accounting practices, but the current and projected budgets show costs that belong to generator or overhead accounts.

For FY 92, WHC is seeking direct funding of 616. USDOE's Activity Data Sheet (ADS) 9215 shows a required operating budget for 616 of $2,850,000 for 1992, and explains the funding basis as follows: "This activity transfers the costs from a chargeback/assessment program to direct funding from the waste operations budget. The costs were derived from operating history gained since 1985..." The FY 92 projection for 616's operating costs includes all the engineering costs in the current budget plus an increase of one-two engineers, a 10 percent escalation factor, an expectation of an increased number of containers per year, a new site-wide hazardous waste tracking system, and the offsite treatment and disposal costs currently not included in 616's budget.

WHC estimates the off-site treatment and disposal costs in the FY 92 projection at $400,000-500,000. The actual treatment and disposal costs for FY 89, however, are $110,000. New Land Disposal Requirements (LDR) may account for some increase in treatment costs, but the estimated disposal costs appear to be excessive even in consideration of LDR requirements and an increased number of containers per year.

The study team notes that the FY 92 projection continues the same cost accounting practice currently in use--all of the engineering costs remain in 616's operating budget. The problem with this practice is that it obscures the actual costs of operating the 616 facility. The engineering costs may be legitimate in the Hazardous Waste Program, but they are not all attributable to 616's operation. This practice may be changed if USDOE-HQ approves the necessary accounting practice change.

Employee training costs contribute $74,100 to the overall operating costs for FY 90. On average, the amount of training employees receive puts 25 percent of the work force in training, and therefore off the job, at any given time. This rate of absence from the job appears to lead to inefficiencies, but the study team recognizes the need for ongoing training, and notes that the 616 training requirements come from one regulatory authority or another.

4. Conclusions

The capital costs associated with the construction of 616 are in line with private sector construction industry standards.

WHC's permit preparation costs for 616, however, exceed comparable private sector costs by $270,000-354,000. WHC's costs are between 2.2 and 3.4 times higher than the study team's private sector estimates.

The analysis of 616's operating costs suffers from a lack of clarity resulting from WHC's cost accounting practices. The study team does not challenge the legitimacy of the engineering costs, but rather finds that their assignment to 616's operating budget makes the task of determining the actual costs of 616 impossible.

The study team notes that the storage costs--even without inclusion of the engineering costs--are much higher than the off-site treatment and disposal costs, and supports USDOE-RL's initiative to re-evaluate its waste management strategy.

The study team finds that the treatment and disposal costs in the FY 92 projection are higher than an historical analysis would suppport, even with adjustments for increased waste volume and for higher treatment costs resulting from new Land Disposal Requirements. By projecting these costs at $400,000-500,000, WHC inflates the overall budget by a significant amount. The exact sum depends on the adjustments for increased volume and LDR-related cost increases, but the FY 89 equivalent costs are $110,000.

APPENDIX A: PRIVATE SECTOR COST COMPARISONS

ERC

11 September 1990

Mr. Jess Abed
Brown and Caldwell Consultants
100 West Harrison
Seattle, Washington

Dear Jess:

This letter presents the final letter report of private sector cost estimates for preparation of Hanford permit documents. The scope of work for this report is described in a June 26, 1990 letter from ERC to Brown and Caldwell Consultants, with written authorization to proceed received from Brown and Caldwell as described your letter received August 2, 1990.

INTRODUCTION

ERC prepared draft budget estimates for private sector preparation of three Hanford documents; a closure plan for 2727-S and RCRA storage permit applications for 616 Nonradioactive Dangerous Facility and 305-B Storage Facility. Preliminary estimates were provided August 8th and August 10th for review. The estimates were prepared assuming that a medium to large engineering firm (500 - 3000 person) prepared the documents for a private entity. This final report is prepared in response to comments from Ecology and information prepared by Hanford contractors.

ASSUMPTIONS

The costs shown are only estimates. Differences between actual costs and the estimates may be attributed to unforseen conditions and situations. Site visits were not conducted prior to preparing the estimates. The following assumptions were made regarding all of the documents reviewed:

- An engineering firm with prior experience in Washington State RCRA regulatory issues and permitting prepared the documents. It is assumed that the firm had a range of staff capabilities and billing rates to assist with accomplishing this type of work.

- Review for the engineering firm is included in the budgets. It is assumed that major review consisted of two senior reviewers and the project manager. Standard firm procedures and controls for items such as text editing and document appearance are presumed adequate. Technical review is included in the specific section budgets. Technical review is presumed conducted by senior technical experts and limited to a specific area such as review of stormwater calculations.

- The client was a private, industrial type client. This assumption is key to several factors that may significantly affect the cost since private clients are usually cost conscious and wish to provide as much assistance as possible to conserve expenditures.

- That the engineering firm had some client contact(s) available to expeditiously provide requested data, drawings, clarifications and decisions.

- Client review provided clear direction with no more than three weeks needed by the client for review at the draft and final stage (six weeks total for client review).

- Data are readily available and easily used by the permit and closure plan preparers. This would imply that drawings are accurate, easily reproduced and require no or minor modifications, that data are provided in a summarized, easy to comprehend format, and that accurate maps and survey information are available.

- Most graphic figures in the reports are based on previously prepared materials. As reflected in the individual estimates, some allowance has been granted for engineering design time and graphic artists for preparation of drawings and figures. It is presumed that maps, survey information, and facility site plans were available from the client.

- All cost estimates presume that two drafts and one final document were prepared for submittal to the regulatory agency. It is assumed that a minimum of 20 pages of agency comments (Notice of Deficiency) was received on the first submittal. It is assumed that 5 to 10 pages of agency comments (2nd NOD) was received on the second draft. It is also assumed that these comments were willingly addressed by the client.

- Although four meetings with regulatory agency representatives would be more standard, an allowance in the budget estimates is made for the required meetings. The project manager and a junior staff person would be the only attendees from the engineering firm. It is assumed that agency staff provided reasonable commentary and direction and that negotiated items were resolved in the meetings.

- Document distribution is limited to 15 copies of draft (1st and 2nd draft for a total of 30) and 15 final documents for regulatory agency, client and engineering company use (total of 45 copies with dividers and binders). Engineering company internal review copies (prior to preparation of distribution copies) are assumed to be on standard copy weight white paper without binders. It is assumed that 7 internal review copies were prepared for each round (21 total internal review copies).

BASIS FOR ESTIMATES

Format Utilization

No allowance for use of the format or text prepared in the first document (616 Dangerous Waste Storage Facility Permit Application) has been included in the estimates for subsequent documents (305-B Dangerous Waste Storage Facility Permit Application). All estimates are prepared assuming that the permit application starts "from scratch". It is presumed that EPA guidance manuals and other permit applications are available for use by the preparer. It is common to follow the format presented in the guidance manuals and in other permit applications as a cost saving measure and most consulting firms would review other applications or guidance prior to commencing work.

Example Permit Applications

A permit application for a single container storage facility is fairly uncommon. Most permit applications are for more complicated offsite treatment and storage facilities with multiple regulated units. As a comparison permit application, a smaller offsite facility in Washington state was selected. This facility has container storage, tank storage and a waste pile. The facility also processes waste. The permit application was prepared by a large (within ENR's top 10 firms), national consulting firm with an office in the Seattle area. Approximate consulting fees billed for permit preparation, closure plan and certified closure of one regulated unit, and a groundwater remediation plan and program preparation totalled $250,000.

Several factors contribute to the cost of this example permit application that are not applicable to the cost estimates for the Hanford documents:

- The example facility had multiple regulated units including storage tanks (which required documentation as to structural integrity) and a waste pile (which required hydrogeological investigation, characterization and monitoring). Movement of wastes from one regulated unit to the other was carefully considered. Operational changes were made at the facility to accommodate permit requirements.

- Costs for the initial hydrogeological investigation (including well installation), preparation of a monitoring plan and a remedial action plan for sulfates are included in the $250,000. Adherence to the requirements and waste piles are not applicable to the Hanford storage facilities.

- The example facility was existing and therefore had to address several anomalies in the application including container storage in rail cars and proving that an existing dry bin feeder complied with the new tank rules.

The example facility handles few waste streams compared to the Hanford facilities, although the waste characterization section is much more detailed in the example facility's permit application. This factor is considered to balance out for the purposes of cost estimating. The example facility initiated the permit application in 1985. The permittee responded to three sets of comments from Ecology, which required one major revision (due to rule changes) and two more minor modifications. A fourth submittal consisting of page changes to correct typographical errors and minor editing was submitted prior to permit issuance. The permit was issued in 1988.

ESTIMATES

The estimates have been provided by section, with data collection, issue resolution and document preparation included in the estimates. A high and low budget figure is provided as shown in the attached estimates. The low budget figure presumes that the client would have a qualified staff familiar with RCRA, that the staff provided easily used information to the engineering firm, and that few questions or issues arose. The high figure is provided for a client that may have a less sophisticated staff but is still able to provide accurate engineering drawings of existing facilities and adequate survey and mapping information. It is presumed that minor additional work was required in the high estimate to prepare the graphics and resolve some of the more complicated issues that may arise. Neither estimate assumes a potential "worst case". Many circumstances can arise that would significantly increase the costs of preparing any document. An attempt to identify, describe and estimate a worst case has not been made.

The summary sheet shows professional labor, graphic and engineering design labor (detailed on a separate sheet), and editing and clerical support labor. The professional labor is an estimate based on the assumptions described above. Graphic and engineering design labor is estimated based on a review of the figures in the documents. Editing time and clerical support are determined as a percentage of other labor.

Production costs are a direct estimate based on the appearance of the document provided and a distribution of copies as described above. Other expenses are estimated as percentage of labor expense.

SUMMARY

This document is intended to provide an estimate for preparation of a RCRA storage facility permit application in the private sector. The estimate is based on comparison of other permit applications and limited review of the Hanford documents. Detailed knowledge of the site(s) and client are not incorporated into the cost estimates. Unforseen circumstances may significantly affect the costs associated with preparing the documents.

If you have any questions, please give me a call.

Sincerely,

Jodi G. Gearon

ESTIMATE FOR PREPARATION OF RCRA PERMIT APPLICATION
305-B Storage Facility

Section	Low Estimate Hours	Rate	Total	High Estimate Hours	Rate	Total
Forward	2	$85	$170	2	$85	$170
Acronyms and Abbreviations	4	$85	$340	8	$85	$680
Part A	40	$85	$3,400	60	$85	$5,100
Part B						
1.0 Introduction	2	$85	$170	2	$85	$170
2.0 Facility Description	40	$85	$3,400	65	$85	$5,525
3.0 Waste Characteristics	50	$85	$4,250	75	$85	$6,375
4.0 Process Information	24	$85	$2,040	60	$85	$5,100
5.0 Groundwater Monitoring	0.5	$85	$43	1	$85	$85
6.0 Procedures to Prevent Hazards	32	$85	$2,720	60	$85	$5,100
7.0 Contingency Plan	50	$85	$4,250	80	$85	$6,800
8.0 Personnel Training	32	$85	$2,720	50	$85	$4,250
9.0 Exposure Information Report	0.5	$85	$43	1	$85	$85
10.0 Waste Minimization Plan	8	$85	$680	10	$85	$850
11.0 Closure/Post Closure	50	$85	$4,250	80	$85	$6,800
12.0 Reporting and Recordkeeping	32	$85	$2,720	48	$85	$4,080
13.0 Other Relevant Laws	20	$85	$1,700	32	$85	$2,720
14.0 Certification	4	$85	$340	6	$85	$510
15.0 References	8	$85	$680	8	$85	$680
Appendices						
2A Topographic Maps	24	$85	$2,040	40	$85	$3,400
4A Design Drawings	60	$85	$5,100	90	$85	$7,650
6A Fire Department Equipment	16	$85	$1,360	40	$85	$3,400
7A Emergency Response Info.	40	$85	$3,400	80	$85	$6,800
8A Job Descriptions	40	$85	$3,400	60	$85	$5,100
Meetings	192	$85	$16,320	192	$85	$16,320
QA Review	62	$85	$5,270	92	$85	$7,820
Subtotal Professional Labor	*833*		*$70,805*	*1242*		*$105,570*
Other Labor						
Editing	167	$55	$9,163	248	$55	$13,662
Clerical Support	125	$38	$4,748	186	$38	$7,079
Graphic Arts	158	$50	$7,900	182	$50	$9,085
Engineering Design	48	$65	$3,120	58	$65	$3,744
Subtotal All Labor			*$95,736*			*$139,140*
Expenses						
Production			$20,000			$50,000
Travel/Repro/Tele/Mail/Etc	18% of Tot Labor		$17,232			$25,045
Subtotal Expenses			*$37,232*			*$75,045*
Total Labor plus Expense			$132,969			$214,186
Contingency 15%			$19,945			$32,128
Estimated Cost - Rounded to Nearest 000			**$153,000**			**$246,000**

Graphic Figures
305-B Storage Facility

Section	8.5 x 11	Other/ Oversize	Design Blueline	Map
Forward				
Acronyms and Abbreviations				
Part A	2	1		
Part B				
1.0 Introduction				
2.0 Facility Description	8			
3.0 Waste Characteristics	1			
4.0 Process Information	2			
5.0 Groundwater Monitoring				
6.0 Procedures to Prevent Hazards	4			
7.0 Contingency Plan	4			
8.0 Personnel Training	0			
9.0 Exposure Information Report				
10.0 Waste Minimization Plan				
11.0 Closure/Post Closure	6			
12.0 Reporting and Recordkeeping				
13.0 Other Relevant Laws				
14.0 Certification				
15.0 References				
Appendices				
2A Topographic Maps				6
4A Design Drawings			4	
6A Fire Department Equipment				
7A Emergency Response Info.				
8A Job Descriptions				
Total Number of Figures	27	1	4	6
Hours per Figure	4	6	12	4
Cover/Tabs/Etc	20			
Total Hours	128	6	48	24
Total Graphic Hours (1+2+4)				158
Engineering Designer Hours				48

ESTIMATE FOR PREPARATION OF RCRA PERMIT APPLICATION
616 Nonradioactive Dangerous Waste Storage Facility

Section	Low Estimate Hours	Rate	Total	High Estimate Hours	Rate	Total
Forward	2	$85	$170	2	$85	$170
Acronyms and Abbreviations	2	$85	$170	2	$85	$170
Part A	40	$85	$3,400	60	$85	$5,100
Part B						
1.0 Introduction	2	$85	$170	2	$85	$170
2.0 Facility Description	50	$85	$4,250	75	$85	$6,375
3.0 Waste Characteristics	40	$85	$3,400	60	$85	$5,100
4.0 Process Information	24	$85	$2,040	40	$85	$3,400
5.0 Groundwater Monitoring	0.5	$85	$43	1	$85	$85
6.0 Procedures to Prevent Hazards	24	$85	$2,040	40	$85	$3,400
7.0 Contingency Plan	50	$85	$4,250	90	$85	$7,650
8.0 Personnel Training	32	$85	$2,720	50	$85	$4,250
9.0 Exposure Information Report	0.5	$85	$43	1	$85	$85
10.0 Waste Minimization Plan	8	$85	$680	10	$85	$850
11.0 Closure/Post Closure	50	$85	$4,250	80	$85	$6,800
12.0 Reporting and Recordkeeping	32	$85	$2,720	48	$85	$4,080
13.0 Other Relevant Laws	20	$85	$1,700	32	$85	$2,720
14.0 Certification	4	$85	$340	6	$85	$510
15.0 References	8	$85	$680	8	$85	$680
Appendices						
2A Topographic Maps	8	$85	$680	32	$85	$2,720
2B Sample Procedures	60	$85	$5,100	80	$85	$6,800
4A Design Drawings	40	$85	$3,400	60	$85	$5,100
4B Containment Calculations	16	$85	$1,360	24	$85	$2,040
8A Sample Training Course	20	$85	$1,700	40	$85	$3,400
11A Sampling Procedure	20	$85	$1,700	32	$85	$2,720
Meetings	192	$85	$16,320	192	$85	$16,320
QA Review	60	$85	$5,100	85	$85	$7,225
Subtotal Professional Labor	*805*		*$68,425*	*1152*		*$97,920*
Other Labor						
Editing	161	$55	$8,855	230	$55	$12,650
Clerical Support	121	$38	$4,598	173	$38	$6,574
Graphic Arts	198	$50	$9,900	228	$50	$11,385
Engineering Design	24	$65	$1,560	29	$65	$1,872
Subtotal All Labor			*$93,338*			*$130,401*
Expenses						
Production			$20,000			$50,000
Travel/Repro/Tele/Mail/Etc	18% of Tot Labor		$16,801			$23,472
Subtotal Expenses			*$36,801*			*$73,472*
Total Labor plus Expense			$130,139			$203,873
Contingency 15%			$19,521			$30,581
Estimated Cost - Rounded to Nearest 000			$\boxed{\$150,000}$			$\boxed{\$234,000}$

Graphic Figures
616 Nonradioactive Dangerous Waste Storage Facility

Section	8.5 x 11	Other/ Oversize	Design Blueline	Map
Forward				
Acronyms and Abbreviations				
Part A	2	1		
Part B				
1.0 Introduction				
2.0 Facility Description	8			
3.0 Waste Characteristics	1			
4.0 Process Information	2			
5.0 Groundwater Monitoring				
6.0 Procedures to Prevent Hazards	4			
7.0 Contingency Plan	4			
8.0 Personnel Training	0			
9.0 Exposure Information Report				
10.0 Waste Minimization Plan				
11.0 Closure/Post Closure	6			
12.0 Reporting and Recordkeeping				
13.0 Other Relevant Laws				
14.0 Certification				
15.0 References				
Appendices				
2A Topographic Maps				2
2B Sample Procedures	12			
4A Design Drawings			2	
4B Containment Calculations				
8A Sample Training Course				
11A Sampling Procedure	2			
Total Number of Figures	41	1	2	2
Hours per Figure	4	6	12	4
Cover/Tabs/Etc	20			
Total Hours	184	6	24	8

Total Graphic Hours (1+2+4)	198
Engineering Designer Hours	24

ESTIMATE FOR PREPARATION OF RCRA CLOSURE PLAN
2727-S Nonradioactive Dangerous Waste Storage Facility

Section	Low Estimate Hours	Rate	Total	High Estimate Hours	Rate	Total
Introduction	80	$85	$6,800	100	$85	$8,500
Closure Performance Standard	24	$85	$2,040	32	$85	$2,720
Estimate of Maximum Inventory	80	$85	$6,800	120	$85	$10,200
Closure Activities	200	$85	$17,000	300	$85	$25,500
Schedule	60	$85	$5,100	80	$85	$6,800
Appendices						
A Checklist	20	$85	$1,700	40	$85	$3,400
B Current Photographs	32	$85	$2,720	48	$85	$4,080
C Spill Reports	12	$85	$1,020	16	$85	$1,360
D Part A Permit Application	16	$85	$1,360	32	$85	$2,720
E 2727-S NRDWS Waste Inventory	12	$85	$1,020	16	$85	$1,360
F Sampling Procedures	24	$85	$2,040	40	$85	$3,400
G Analytical Plan	32	$85	$2,720	80	$85	$6,800
H Certifications	8	$85	$680	16	$85	$1,360
Other Professional Labor						
Site Visit	32	$85	$2,720	40	$85	$3,400
QA Review	60	$85	$5,100	92	$85	$7,820
Subtotal Professional Labor	*692*		*$58,820*	*1052*		*$89,420*
Other Labor						
Editing	138	$55	$7,612	210	$55	$11,572
Clerical Support	104	$38	$3,944	158	$38	$5,990
Graphic Arts	150	$50	$7,500	173	$50	$8,625
Engineering Design	0	$65	$0	0	$65	$0
Subtotal All Labor			*$77,876*			*$115,613*
Expenses						
Production			$25,000			$45,000
Travel/Repro/Tele/Mail/Etc	18% of Tot Labor		$14,018			$20,810
Subtotal Expenses			*$39,018*			*$65,810*
Total Labor plus Expense			$116,894			$181,424
15% Contingency			$17,534			$27,214
Total			$134,428			$208,637
Rounded Total	**Rounded Total**		**$135,000**			**$210,000**

Graphic Figures
2727-S Storage Facility

Section	8.5 x 11	Other/ Oversize	Design Blueline	Map
Introduction	3	1		
Closure Performance Standard	1			
Estimate of Maximum Inventory	0			
Closure Activities	6			
Schedule		3		
Appendices				
A Checklist				
B Current Photographs		11		
C Spill Reports				
D Part A Permit Application				
E 2727-S NRDWS Waste Inventory				
F Sampling Procedures				
G Analytical Plan				
H Certifications				
Total Number of Figures	10	15	0	0
Hours per Figure	4	6	12	4
Cover/Tabs/Etc	20			
Total Hours	60	90	0	0
Total Graphic Hours (1+2+4)				150
Engineering Designer Hours				0

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

90-TPA-033

OCT 0 5 1990

Mr. Timothy L. Nord
Hanford Project Manager
State of Washington
Department of Ecology
Mail Stop PV-11
Olympia, WA 98504-8711

Dear Mr. Nord:

REVIEW OF ERC COST ASSUMPTIONS

We have completed a review of the cost assumptions provided by letter dated September 11, 1990, from Jodi G. Gearon, ERC, to Jess Abed, Brown and Caldwell. Based upon this review, we believe that the costs are understated due to a failure to consider the costs which would typically be incurred by the client in the preparation of a permit application or closure plan. Our specific comments are listed below:

1. Review costs consider only ERC staff review. No consideration was given to the review costs of the client or of review for precedent-setting commitments in the permit application or closure plan. Rather the costs considered only very technical reviews, similar to the review that a regulator would be expected to make.

2. One assumption is that all needed data would be readily available. Again, no consideration is given to the costs the client would incur in gathering the data for the contractor. An optimum situation would be that all required technical data, maps, etc. would be readily available for transfer to the contractor, but this is seldom the case.

3. The assumption that NOD comments would be "willingly addressed by the client" does not consider that resolution of comments must consider the impact to other waste management units. A facility such as Hanford cannot afford to respond to NOD comments without first understanding the implication of those comments to other regulated waste units. Once again, no consideration is given to the client costs.

4. No consideration appears to have been given to the labor costs associated with the generation of information, gathering of information, and confirmation of information. The inclusion of these very real costs could increase the estimates by as much as a factor of two.

5. It would be helpful to cite the actual percentage used to determine editing time and clerical support and why this approach was selected.

6. The document production costs are understated due to the limited number of copies which are assumed to be required: 15 copies for each review and 15 final copies. The Hanford Federal Facility Agreement and Consent Order requires that one copy be placed in each of the four public information repositories and one copy be placed in each of the three Administrative Record files. In addition, both EPA and Ecology require at least two copies. With only 15 copies produced, this would leave one copy for the consulting firm, one copy for the owner/operator (DOE-RL), one copy for the co-operator (WHC), and one copy for DOE-HQ. This is not realistic.

7. The Hanford Site has certain requirements regarding editing and document production (e.g., union shop and Government Printing Office considerations). While we agree that it may be possible to achieve cost reductions in this area, the magnitude of the cost reductions will be limited due to DOE Orders which document production standards.

I hope that you will consider these comments prior to finalizing your cost study to ensure that any comparisons consider all appropriate factors, including the client costs which must always be incurred when an outside firm is utilized.

Thank you for the opportunity to review the ERC estimates for permit/closure plan preparation. If you have any questions regarding these comments, please call me on (509) 376-6798, or Mr. Tim Veneziano, Westinghouse Hanford Company, on 509 376-0543.

Sincerely,

S.H. Wi

Steven H. Wisness
Hanford Project Manager

ERD:SHW

cc:
T. B. Veneziano, WHC
P. T. Day, EPA

APPENDIX B: INTERVIEWS

APPENDIX B

BROWN AND CALDWELL CONSULTANTS
RECORD OF INTERVIEWS

Unit	Affiliation/Personnel	Date/Place
Kickoff Meeting	*BCC* Jess Abed Hal Cooper Robin Grant Jon Sprecher *DOE-RL* Rich Hudson Steve Wisness Jim Rasmussen *Ecology* Tim Nord *EPA* Paul Day *PNL* Bill Bjorklund *PRC* Deidre O'Dwyer Donna LaCombe *WHC* Hal Downey Karl Fecht Lynn Mize Fred Ruck III Curtiss Stroup Tom Wintczak	
305-B	*BCC* Jess Abed Hal Cooper *Ecology* Tim Nord *PNL* Bill Bjorklund Glen Thornton *WHC* Lynn Mize	05-04-90 Hapo Building, Richland, WA
616-S	*BCC* Jess Abed Robin Grant *Ecology* Tim Nord *WHC* Carol Geier Sue Price Lynn Mize Randy Roberts Randy Slaybaugh	05-11-90 Hapo Building, Richland, WA

2727-S	*BCC* Jess Abed Robin Grant *Ecology* Tim Nord *WHC* Carol Geier Lynn Mize Linda Powers Rex Thompson	05-11-90 Hapo Building, Richland, WA
Well-Installation & Drilling Costs (General)	*BCC* Jess Abed Robin Grant Jon Sprecher *DOE-RL* Jim Patterson *WHC* Hal Downey Tom Wintczak	05-15-90 Hapo Building, Richland, WA

Unit	Affiliation/Personnel	Date/Place
Well-Drilling & Installation Costs	*BCC* Mark Liebe Jon Sprecher *WHC* Duane Horton	05-16-90 450 Hills Bldg, Richland, WA
	BCC Mark Leibe Jon Sprecher *WHC* Wayne Jonhson	05-16-90 450 Hills Bldg, Richland, WA
	BCC Mark Leibe Jon Sprecher *WHC* Tom Wintczak	05-16-90 450 Hills Bldg, Richland, WA
	BCC Jon Sprecher *DOE-RL* Mike Thompson	05-22-90 Federal Bldg, Richland, WA
	BCC Robin Grant Jon Sprecher *WHC* Mel Adams	05-23-90 Hapo Building, Richland, WA
	BCC Robin Grant Jon Sprecher *WHC* Tom Wintczak	05-23-90 Hapo Building, Richland, WA
	BCC Robin Grant Jon Sprecher *WHC* Rick Ashworth	05-23-90 Hapo Building, Richland, WA
	BCC Robin Grant Jon Sprecher *WHC* Bruce Agee	05-23-90 Hapo Building, Richland, WA

Well-Installation & Drilling Costs (CERCLA)	*BCC* Robin Grant Mark Liebe Jon Sprecher *DOE-RL* Jim Patterson Nancy Werdef *WHC* Hal Downey Dwayne Horton Linda Powers Rex Thompson Tom Wintczak	05-15-90 Hapo Building, Richland, WA
Well-Installation & Drilling (RCRA)	*BCC* Jess Abed Robin Grant Jon Sprecher *COE* Michael Fellows John Sager James Warriner *KEH* James Lilly *WHC* Bruce Agee Rick Ashworth Bruce Gilkeson Duane Horton Brian Thomas	05-22-90 Hapo Building, Richland, WA

Unit	Affiliation/Personnel	Date/Place
300-Area Wastewater Treatment Plant	*BCC* Jess Abed Hal Cooper Jon Sprecher *WHC* Mark Carrigan Vern Dronen Bob Fritz Lynn Mize Brian Thomas	06-01-90 Hapo Building, Richland, WA
200-BP-1	*BCC* Jess Abed Hal Cooper Jon Sprecher *DOE-RL* Nancy Werdef *WHC* Rich Carlson Wayne Johnson Brian Thomas Tom Wintczak	06-01-90 Hapo Building, Richland, WA
Laboratory & Analytical Costs	*BCC* Jess Abed Hal Cooper Jon Sprecher *WHC* Lynn Mize Linda Powers Curtiss Stroup Brian Thomas	06-01-90 Hapo Building, Richland, WA
General/Financial	*BCC* Jess Abed Robin Grant *Ecology* Tim Nord *WHC* Bruce Agee Bedoy Austin Lynn Mize Lowell Patterson Brian Thomas	05-24-90 Hapo Building, Richland, WA

DOE-RL	*BCC* Jess Abed Robin Grant *DOE-RL* Roger Freeberg Ron Light Patty Morehouse Bob Tibbatts *Ecology* Tim Nord	05-24-90 Federal Bldg., Richland, WA

Telephone Log

Name	Organization	Date
Jim Peterson	DOE-RL	09/04/90
Bill Rutherford	DOE-RL	09/05/90
Steve Wisness	DOE-RL	09/06/90
Roger Freeburg	DOE-RL	09/11/90
Bob Tibbatts	DOE-RL	09/11/90
Bill Bjorklund	PNL	09/10/90
Roger Bowman	WHC	09/10/90
Linda Powers	WHC	08/31/90
Sue Price	WHC	08/31/90
Theresa Hennig	DOE-RL	08/31/90 09/06/90
Debbie Trader	DOE-RL	09/06/90
Brian Thomas	WHC	09/06/90

COST EVALUATION PROJECT

SECTION 2

U.S. DEPARTMENT OF ENERGY
HANFORD SITE
RICHLAND, WASHINGTON

conducted by

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION 10
HANFORD PROJECT OFFICE

OCTOBER 1990

COST EVALUATION PROJECT

SECTION 2

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

A. INTRODUCTION

The U.S. Environmental Protection Agency (EPA) conducted reviews in three separate areas, as part of the joint State of Washington Department of Ecology (Ecology) and EPA cost evaluation project. PRC Environmental Management, Inc., (PRC) a private environmental consulting firm, assisted EPA by gathering much of the factual information used in the study and by conducting the final review of this report. In this way, EPA was able to access various technical specialties through PRC and its subcontractors. EPA selected its projects for review based on the following factors:

- Feasibility of project or topic cost evaluation; i.e., whether sufficient cost information existed to facilitate a review and evaluation;

- Potential to significantly reduce costs in the Superfund program;

- Relevance of project or topic to similar projects or topics; i.e., the results of the study would be representative and applicable to other similar projects or topics or would have site-wide applicability; and

- Division of responsibility and potential redundancy with projects selected by Ecology;

The EPA selected three separate projects or topics for evaluation, based on the above mentioned criteria:

1. <u>200-BP-1 Operable Unit Remedial Investigation and Feasibility Study (RI/FS).</u> This project fit the selection criteria well, in that an active Superfund investigation is underway and some of the costs can be used to verify the RI/FS cost model that was developed by Westinghouse Hanford Company (WHC) for cost RI/FS projections. The first investigation in a radioactive zone is taking place at this operable unit and it is a combined source and groundwater operable unit. Seventy-eight operable units have been defined for investigation, so the findings from this project will have broad applicability. WHC estimated the RI/FS cost at this operable unit to be over $27 million. Therefore, the magnitude of the project is sufficient to have a significant impact on the budget needs if cost saving measures could be identified.

2. <u>300-Area Process Water Treatment Plant.</u> This project was selected as it was the only area that specifically considered design, engineering, and construction costs. EPA expects that other treatment facilities and construction projects will be completed over the life of the <u>Hanford Federal Facility Agreement and Consent Order</u> (Tri-Party Agreement) and this evaluation should provide some carryover benefit to those future projects. Two designs for this treatment plant were initially considered as part of this cost evaluation, a $15 million design and a $39 million design.

3. <u>Laboratory Analysis Costs.</u> EPA selected this topic for review due to its high total cost, both in the near term and over the duration of the Tri-Party Agreement. The magnitude of the laboratory analysis program is so great that even small percentage cost savings would translate in significant overall reductions in budget needs. Laboratory costs apply to both the Superfund and Resource Conservation and Recovery Act (RCRA) programs, as covered under the Tri-Party Agreement, and to other ongoing programs at Hanford, as well.

The EPA and PRC review began with a kick-off meeting on May 3, 1990, with key individuals from the Department of Energy (DOE) and WHC. Subsequently, a series of interviews and site visits were held by PRC and additional information needs were identified. After the initial draft report was prepared in July 1990, EPA began to work closely with PRC to finalize the report. During this period, additional information and data needs were identified and the report went through several iterations. Upon completion of the drafts for each of the three sections mentioned above, EPA submitted the drafts to DOE and WHC for a limited time for technical accuracy review. This review was limited to the factual information only, and not to EPA's conclusions or recommendations. DOE and WHC had no significant comments on these sections.

EPA designed this cost evaluation project as a means to provide an independent assessment of the costs necessary to implement the Tri-Party Agreement at Hanford. This consisted, in part, of reviewing the accuracy of proposed costs estimated by DOE and WHC. In some cases, the estimates were based on historical incurred costs, while other Superfund related tasks had never been performed at Hanford and "best engineering judgement" was used to prepare the cost estimates. EPA considered the logic behind the cost estimates and, in some cases, recommended that the process itself be changed to allow lower costs, while maintaining a work product of acceptable quality. EPA considered and compared Hanford's cost estimates to experience obtained in the private sector, to the extent possible. Certain factors that must be considered at Hanford (e.g., security issues, certain labor issues, and varying levels of radioactive waste), can not be compared directly to the private-sector experiences outside of Hanford.

B. GENERAL FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Each of the three projects or areas reviewed by EPA contains specific evaluations and a summary and recommendation section. This section is intended only to point out some of the general findings and trends noted during the evaluations.

First, it was apparent that many of the costs were not substantiated. WHC requested various internal groups to identify the costs associated with specific tasks. That information was provided, but the reviewers were unable to document any effort by which WHC challenged the costs provided from one branch to another. The reviewers could not determine whether a suitable internal mechanism for requiring documentation of costs existed or who the final arbiter might be in case of a dispute. One obvious example of this practice was noted in the 200-BP-1 Operable Unit RI/FS review, where the monthly hours for a radiation protection technician were recently changed from the normal rate of 160 hours per month to 224 hours per month to accommodate training needs. Not only is this rate inconsistent with all other disciplines related to RI/FS work which still identify a rate of 160 hours per month, but the rate of 224 hours per month is excessive. Training needs identified at 40 percent of an individual's time (two days per week) on a permanent basis should have been called into question immediately and challenged as inappropriate. This is but one example to show the need for WHC to scrutinize the numerous elements or subtasks that make up the costs for its projects. A mechanism for challenging and rejecting costs that can not be substantiated should be implemented. Likewise, DOE needs a mechanism by which it can ensure that project costs have been carefully reviewed prior to issuing its approval. A value engineering approach and review of WHC's proposed project costs by DOE's general support contractor would be a logical step for DOE to consider.

EPA's second observation is that the mission at Hanford is rapidly changing from that of a defense materials production site to that of a model for environmental restoration. In this period of change, it is quite likely that many of the operating requirements, procedures, and orders generated by both DOE and its contractors may need to change. EPA realizes that changes to long instituted practices may not come easy, but recommends that DOE and WHC institute a review process of the various requirements now in place at Hanford, as they apply to Tri-Party Agreement related activities. It may be possible to streamline, tailor, or even eliminate certain requirements that currently apply to these activities.

Third, with the exception of the 300-Area Process Water Treatment Plant, DOE and WHC were frequently not able to provide defensible and detailed bases for their cost estimates. As an example, the term "best engineering judgement" was often used to support the estimates. For certain tasks, DOE and WHC should have been able to draw from historical cost information to predict future costs in an accurate manner. However, even historical or incurred costs did not always provide sufficient information for WHC to construct detailed cost estimates for activities reviewed under this cost evaluation project. These deficiencies resulted in less detailed information for the reviewers and the results of this evaluation should be viewed accordingly.

In addition to the general observations noted above, general findings were noted in each of the three projects or topics reviewed, as follows.

<u>200-BP-1 Operable Unit RI/FS</u> -- The RI/FS cost model is of limited use in its present form because specific adjustments must be made for each operable unit. The current model does not include the sensitivity necessary for these adjustments. The model was a good first attempt to document cost projections and provide continuity, but the model should be expanded to include more detail on the assumptions, to document the assumptions for each subtask, and to provide increased sensitivity to deal with the variability of each operable unit. Definition of specific tasks will assist WHC in preparing the most accurate estimates possible and will facilitate a thorough review of the model as it applies to each operable unit.

The level of effort, labor costs, and the time frames associated with various tasks appeared to be high. Examples of this include the number of people required for drilling activities, the level of effort associated with document or report preparation, and labor rate quotes of $13,000 per month for a radiation protection technician. The amount of time devoted to training also appeared high. These areas are all discussed in more detail in the evaluation of the 200-BP-1 Operable Unit RI/FS cost estimate. These issues all relate back to the need for WHC and DOE to document, and perhaps challenge, the level of effort planned for certain specific activities and, in some cases, to determine whether certain activities are even required or serve a useful purpose. They also relate to the "unit cost" of activities.

EPA recommends that DOE and WHC closely evaluate and substantiate the cost estimates and quotes that are used in the model.

<u>300-Area Process Water Treatment Plant</u> -- EPA did not find major discrepancies in the capital cost projections for construction of the physical plant. Some of the line item costs were higher than EPA found through contact with vendors and some costs were lower. The evaluation could not be done in-depth, since the detailed plans and specifications have yet to be developed. The evaluation focused on the $15 million design, since the more expensive design was rejected by WHC. This decision was made because the estimated cost was well beyond the available budget limitation.

EPA believes that there is some danger in limiting the design to 300 gallons per minute (gpm), even though WHC hopes to achieve a flow rate of approximately 200 gpm by May 1993. This requires a high degree of confidence that the waste stream can be reduced to 200 to 300 gpm from the current 1200 gpm through waste minimization activities at a time when budget forcasting has a high degree of uncertainty. There appeared to be no contingency for treating amounts in excess of 300 gpm in the event that all necessary waste minimization efforts can not be achieved. Additionally, there was apparently no attempt to coordinate process water treatment and contaminated groundwater treatment. Although the analysis of a combined treatment system was not required by the Tri-Party Agreement, EPA recommends that DOE consider a combined system for treatment of effluent and contaminated groundwater. This may or may not be feasible, but EPA recommends that it be considered as a potential cost-effective measure which could eliminate a separarate treatment system for groundwater treatment. While EPA recognizes that speculation on treatment of groundwater at this time is difficult and that there should be no predisposition to the record of decision for cleanup in the 300-Area, a substantial amount of information exists on the contaminated aquifer that could be used for general consideration or feasibility of a combined treatment system.

Most of the design and engineering fees for the treatment plant appeared reasonable; however, the Kaiser Engineer Hanford (KEH) engineering fees, the costs for buildings and sump 1, and the costs for overhead and profit/bond and insurance for packaged process equipment seemed high. EPA recommends that as DOE conducts its project validation as the definitive design is completed, particular attention be given to verifying and substantiating these costs.

Laboratory Analysis Costs -- This review was particularly difficult for EPA, since WHC could not provide detailed cost factors related to laboratory analyses. In addition, the method of assessing user fees to the various groups onsite made the comparison to the private-sector laboratories difficult. Additionally, very little could be done to compare analytical costs for radioactive or mixed waste samples to the private-sector since most laboratories in the private-sector do not conduct such analyses. Therefore,much of EPA's findings had to do with nonradioactive analyses, which could be compared to offsite laboratories.

It appeared that the cost of analyzing nonradioactive samples onsite at Hanford at this time is about twice what it costs in the private-sector. Even with the difficulty in comparing Hanford laboratories to private-sector laboratories, this is a significant difference and merits further detailed investigation by DOE, WHC, and Pacific Northwest Laboratories.

EPA was not convinced that DOE and WHC had done a thorough job of cost benefit analysis for the proposed laboratory upgrade program. It appeared that presently, and even after the laboratory upgrades are completed at a substantial expense, it may be less expensive to have samples with radioactivity levels of less than 1 mR/hour analyzed at private laboratories offsite. EPA recommends that this issue be studied carefully, including one scenario for laboratory upgrades focusing on samples greater than 1 mR/hour.

The remainder of this report consists of a discussion of each of the three projects or topics discussed above in detail.

C. 200-BP-1 OPERABLE UNIT REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

1. BACKGROUND

The 200-BP-1 Operable Unit is one of 78 operable units identified to date at the Hanford site that will undergo investigation and remediation. The unit is located in the separations area (200-Area) of the Hanford site; the 200-Area is divided into the 200 East Area and the 200 West Area. The 200-BP-1 Operable Unit is located along the northern boundary of the 200 East Area. The unit encompasses 25 acres, although the majority of the waste management units are concentrated within a 4-acre area (DOE, 1989b).

The primary function of the 200-Area Facilities was to reprocess irradiated fuel for separation and recovery of certain isotopes such as plutonium and uranium. The 200-BP-1 Operable Unit contains 13 identified individual waste management units—10 cribs and 3 spills. The cribs, which are essentially leach fields for mixed (i.e., radioactive and hazardous) wastes, were used to dispose of millions of gallons of wastewater during the 1950s and 1960s. The cribs received liquid waste from U-Plant uranium reclamation operations and waste storage tank condensate from the 241-BY Tank Farm. The spills, or unplanned releases, were the result of tank farm operations.

2. DESCRIPTION OF DOE'S RI/FS COST PROJECTIONS

Since April 1990, the planning process for all RI/FS work plans has begun with a project scoping meeting attended by the assigned Unit Managers from DOE, EPA, and Ecology, an assigned technical lead from WHC, and other technical support staff including subcontractors. However, this scoping meeting was not held prior to development of the 200-BP-1 Operable Unit Work Plan, as the procedure of involving EPA and Ecology during the early planning stages had not yet been instituted. WHC and its subcontractors prepared the work plan for the 200-BP-1 Operable Unit using EPA guidance documents as the primary guidelines, supplemented by information and guidance from EPA, the lead regulatory agency for this operable unit.

The DOE Monitor (in this case, the Unit Manager) is the person responsible for review of the 200-BP-1 RI/FS Work Plan and its associated cost estimate. In this instance, the DOE Unit Manager and a general support contractor to DOE reviewed the work plan and the cost estimate compiled by WHC.

The DOE's Five-Year Plan which projects work estimates and associated costs for environmental restoration projects is prepared annually and forms the basis for DOE's funding requests to Congress. Activity Data Sheets (ADS) include current year and out year funding requirements and a narrative description of specific projects and activities. The ADSs are used to support the budget requirements in the Five-Year Plan. The costs provided in the ADSs for the Hanford Site were compiled using a Cost Account Plan (CAP) for the current fiscal year costs and a computer model for outlying years. The cost-estimating model for RI/FS work was developed in September 1989 by WHC. Prior to the model, WHC developed general estimates for the first four operable units (1100-EM-1, 200-BP-1, 300-FF-1, and 100-HR-1) for inclusion in the initial Five-Year Plan. The original estimates ranged between $12,000,000 and $13,000,000 (Wintczak, 1990a). These original estimates were replaced with the model generated estimates, i.e., $27,200,000 for 200-BP-1 Operable Unit. Costs for the other three operable units mentioned above also increased under the new model, but not as significantly as with the 200-BP-1 Operable Unit.

The CAP for each project was developed by the WHC Cost Account Manager (CAM). The CAP was subdivided into work packages, which were further divided into task packages. Each organization potentially responsible for executing a particular task was consulted to predict labor effort and associated costs needed for the current fiscal year. The responsible organization was then asked to commit the required number of people to conduct the task and verify this commitment with an approval signature.

3. COST-ESTIMATING MODEL DEVELOPED FOR THE RI/FS

The WHC cost-estimating model is an order-of-magnitude cost-estimating tool based on conservative assumptions developed to represent a typical RI/FS process conducted at Hanford. An order-of-magnitude model, as defined by EPA, has an accuracy for which a final cost falls within the range of +50 percent to -30 percent of the cost estimated at the site (Burgher et al, 1987). The assumptions involved typical RI/FS tasks, initiation dates, execution time frames, labor requirements, and associated costs. The model is a computer-based algorithm that distributes estimated costs over assumed time frames for each RI/FS task.

The RI/FS tasks included in the cost-estimating model are described in detail in the next section of this report. These tasks include:

- project management,
- scoping,
- preparation and review of primary documents (i.e., work plans, RI Reports, FS Reports),
- site characterization and nonintrusive field activities,
- staff training and startup,
- drilling activities (preparation and execution),
- borehole abandonment,
- hazardous waste disposal and decontamination,
- chemical analysis,
- physical analysis,
- groundwater monitoring,
- performance assessment,
- treatability studies, and
- environmental assessment.

The assumed time frames used in the model were developed based on engineering judgement and, where possible, historical data available for similar onsite activities. Engineering judgement is a common cost-estimating tool that refers to the method of using previous engineering experience to generate cost numbers. The estimated costs for each task were obtained from, and approved by, the organizations responsible for executing a specific task. Typically, the estimates were provided as a lump sum (i.e., total cost for executing the task). The model was constructed to evenly distribute the lump sum over the assumed time frame for each task. A monthly cost requirement was then developed for each task based on this lump sum estimate. Appendix A provides the model's detailed set of assumed time frames and estimated costs for the RI/FS tasks.

In addition, WHC developed a matrix (see Appendix B) to factor the number of waste sites per operable unit into specific RI/FS tasks. This matrix was integrated with the model assumptions given in Appendix A to generate a cost estimate specific to each operable unit. Details of the matrix information for the 200-BP-1 Operable Unit are given in the next section of this report.

At the time the model assumptions were compiled, a DOE directive mandated that all primary RI/FS documents be completed by a firm that is not responsible for implementing the remedy. WHC, then, had the option of using WHC contractors or Battelle's Environmental Management Operations (EMO) and EMO's contractors for document preparation tasks. The estimates provided in Appendix A that involve contractor or EMO participation were estimated for each group separately. When using the model to generate a cost estimate for a specific operable unit, DOE determined whether the support was going to be supplied by a WHC contractor or by EMO and its contractors. The appropriate monthly cost, as described in the next section and in Appendix A, was then used in generating the cost estimate.

DOE Order 5400.4, recently issued by DOE Headquarters, requires that an organization other than WHC conduct the RI/FS. It was thought that this organization would be EMO. It now appears that DOE will be soliciting bids for a major contract to be awarded to another firm to conduct the RI/FS work. WHC will continue its present role until that new contract is awarded.

In a separate action, DOE has recently entered into an interagency agreement with the U.S. Army Corps of Engineers, Walla Walla District Office, to perform a portion of the RI/FS work at the Hanford Site. Under this agreement, the Corps will have full responsibility over specified RI/FS projects and have other site-wide responsibilities related to the Environmental Restoration program. In regard to direct RI/FS oversight, the Corps will assume management of the ongoing work at the 1100-EM-1 Operable Unit and will initiate the RI/FS program at the 100-FR-1 Operable Unit in fiscal year 1992.

The effects that the above mentioned directives will have on the cost-estimating structure is unknown. It is possible that cost-estimating will become the responsibility of the new organizations and that this model may be modified or become obsolete. The cost of transition of work to other organizations is not known at this time, but it will most likely affect costs. These transition costs and any other costs that can be attributed to management by multiple organizations should be closely tracked and documented for the purpose of future evaluation.

The cost-estimating model includes a trend system, or updating procedure, by which WHC will acquire and record information, such as actual task time frames and incurred costs for RI/FS activities. Information that impacts all RI/FS work done at Hanford would be incorporated into the general model so that each operable unit cost estimate generated using the model in the future would assimilate the new information. As an example, the work plan review process has been condensed by 3 months because a concurrent DOE and regulatory agency review has been implemented. Therefore, the cost in the general model for the work plan review task should be adjusted to reflect this change.

On the other hand, information that is specific to one operable unit would only be incorporated into that operable unit's cost estimate. For example, the conservative assumption that all drilling would be conducted in a radioactive zone was incorrect for the 200-BP-1 Operable Unit. A majority of the new groundwater wells will be installed outside radioactive zones. Therefore, the manpower requirements should be reduced because the health and safety level of effort will be reduced. In this case, only the 200-BP-1 Operable Unit cost estimate would be adjusted to reflect this change.

The trend system was scheduled to be executed annually (when the new ADSs were being developed) unless a major cost impact was noted. For example, the general model was adjusted when substantially increased analytical costs were quoted from the onsite laboratories (Wintczak, 1990c). New information for the trend system is collected throughout the year.

4. COST-ESTIMATING MODEL APPLIED TO 200-BP-1 OPERABLE UNIT

The 200-BP-1 Operable Unit cost estimate generated by WHC's model is provided in Appendix C. The estimate incorporated the assumptions in Appendix A and the 200-BP-1 Operable Unit matrix information provided in Appendix B. The projected total cost for the 200-BP-1 Operable Unit RI/FS is $27,200,000. Table C-1 provides a breakdown of the cost by major task categories.

The 200-BP-1 Operable Unit cost estimate was generated before work plan approval (the work plan was approved March 16, 1990); therefore, certain assumptions had to be made regarding the scope of the field investigation. The tasks affected by these scope assumptions include drilling, sampling, hazardous waste disposal and decontamination, borehole abandonment, and sample analysis. These assumptions are based on the number of waste management units or waste sites present at an operable unit. The number of waste sites was factored into drilling duration, number of samples, cost of

TABLE C-1

200-BP-1 OPERABLE UNIT COST ESTIMATE

TASK	COST
Project Management	$5,372,000
Scoping	495,000
Document Preparation and Review:	
Work Plan	1,051,000
Remedial Investigation Report	2,040,000
Feasibility Study Report	2,040,000
Site Characterization and Non-Intrusive Field Activities	2,000,000
Staff Training and Startup	432,000
Drilling (including preparation)	2,765,000
Borehole Abandonment	280,000
Hazardous Waste Disposal and Decontamination	1,326,000
Sample Analysis	3,640,000
Physical Analysis	350,000
Groundwater Monitoring	759,000
Performance Assessment	600,000
Treatability Studies	3,000,000
Environmental Assessment	1,050,000
TOTAL	**$27,200,000**

decontamination, and cost of hazardous waste disposal. The factoring was dictated by the model assumptions presented in Appendix A under tasks 3.8 and 3.9. (For example, the number of vadose zone boreholes = 3 x the number of waste sites.) The matrix, developed by WHC, detailing the factors for several operable units (including the 200-BP-1 Operable Unit) is given in Appendix B.

The trend system will be employed to refine the model over time. The 200-BP-1 Operable Unit cost estimate was largely constructed on estimates and best engineering judgement not on actual RI/FS experience. The trend system will allow for modifying the cost-estimating model. Information acquired over the course of the previous year can be evaluated annually to determine if adjustments to the model or the specific operable unit's cost estimate are necessary. The 200-BP-1 Operable Unit cost estimate might be impacted by a variety of information gathered over fiscal year 1990 as discussed below.

First, investigative work at the 1100-EM-1 Operable Unit is further along than that for 200-BP-1 Operable Unit (RI Phase I Report was submitted August 31, 1990) and some incurred RI/FS costs are now available for evaluation and comparison, and for possible application for similar work to be done at the 200-BP-1 Operable Unit. In addition, the work plan for the 200-BP-1 Operable Unit was recently approved (March 16, 1990) and the scope of the initial investigation is now well defined (for example, number of vadose zone boreholes, depth of boreholes, and number of new monitoring wells).

Also, revised projections from work groups have been received. For example, the RPT management has modified its funding requirements to ensure adequate staffing of RI/FS tasks. It now requires 224 hours of funding (not 160 hours) to have one RPT on the job for a month. The extra hours were requested to cover update training (i.e., extra hours to allow an alternate worker to assume RPT duties while the original worker is attending update training). The example of RPT training will be further discussed under the staff training element in the next section.

5. COST ESTIMATES AND COST EVALUATION FOR THE 200-BP-1 OPERABLE UNIT

This section consists of a discussion of: (a) assumptions used in WHC's RI/FS cost model; (b) how that model was used to create the 200-BP-1 Operable Unit RI/FS cost estimate; and (c) the reviewers' evaluation of that cost estimate and the model from which it was derived. Each of the fourteen tasks described in the RI/FS model (shown on Table C-1) are discussed in terms of these three considerations.

1. PROJECT MANAGEMENT

1a. Assumptions Used in Model (See Page A12)
The management task estimate was obtained from the WHC field services and environmental engineering groups based on historical costs. The historical costs are derived from like costs incurred during past activities at Hanford. The costs for support groups were included under this task. The RI/FS activities were just underway; therefore, directly related RI/FS incurred costs for project management were not available. This task also included involvement by upper level management, support for compiling and keeping project files, scheduling, and administration.

1b. Model Applied to Cost Estimate for 200-BP-1
The $5,372,000 cost for project management was generated using the model's monthly task rate of $68,000 (see Page A12) for 79 months (the duration of the 200 BP-1 Operable Unit RI/FS from the initiation of preliminary field activities through the Record of Decision (ROD).

1c. Evaluation of Model and 200-BP-1 Cost Estimate
The specific tasks covered under the project management heading were not well defined. Since the category is not as specific as certain other categories (e.g., borehole abandonment), there is a potential for this to become a "catch-all" category. For this reason, care must be taken that only legitimate activities related to management of each RI/FS project are included. There are some basic management costs that are incurred on every project. It is important to note that this cost is a function of the complexity of the project and the client's needs. Hanford's special factors play a substantial role in the cost of this task; however, the level of effort required for project management should be justified by detailing subtask descriptions and personnel groups assigned to each subtask and the associated level of effort, such that an outside

reviewer can evaluate the costs and have a basis to agree or disagree.

The 200-BP-1 Operable Unit project management cost is 20 percent of the direct and indirect costs for this project. A large project such as this one (in terms of dollars), should exhibit a lower percentage of the total cost for this task. Table C-2 shows a comparison to private sector project management costs. The contrast is significant, in that a large private sector project has estimated management costs of only 3 percent of direct and indirect costs. The small private sector project, which would typically require a higher percentage for management costs, estimated only 9 percent of direct and indirect costs. This comparison illustrates that two actions should be taken. First, as stated above, DOE and WHC must clearly identify each task and subtask that is included in project management category. Second, DOE and WHC must closely review the tasks and associated costs to see whether they are appropriate and absolutely necessary for completion of the project. This includes review of those factors considered to be unique to Hanford.

The reviewers do not agree that a total project management cost of $5,372,000 can be justified. The monthly rate of $68,000 is more than six times the rate experienced for typical large projects in the private sector. Additionally, the model does not give credit for economies that will be realized from a single management structure for numerous operable units.

One specific element of the cost model merits further discussion. The element of "Procedure Preparation" (see page A12) is included at a cost of 640 hours (or $36,000) per month throughout the duration of this task (79 months, as discussed above). The reviewers do not believe that this level of effort can be justified. Obviously, the specific subtasks to be performed as part of procedures preparation should be defined. It is not reasonable to assume that procedures of any type are being prepared for a single operable unit over the period from initiation of preliminary field work through the ROD. Further, while certain procedures should be developed in consideration of specific oper ble unit conditions, it is not reasonable to ass e that all procedures should be "redeveloped" for each operable unit. This seems to be what the model would propose. The area of procedures preparation, as included in the model, should be closely scrutinized by DOE and WHC. The reviewers believe that substantial

TABLE C-2
PRIVATE-SECTOR COST COMPARISON

TASK	200-BP-1 OPERABLE UNIT	PRIVATE SECTOR	
		Small Project	Large Project
Project Management	20% of direct & indirect costs[1] ($68,000/month)	9% of direct & indirect costs ($3,000/month)	3% of direct & indirect costs ($11,000/month)
Work Plan	4% of direct & indirect costs ($1,051,000)	6% of direct & indirect costs ($31,000)	6% of direct & indirect costs[2]
Scoping	2% of direct & indirect costs ($495,000)	7% of direct & indirect costs ($37,000)	7% of direct & indirect costs[2]
Rig Decontamination	$18,000/hole (radiological & hazardous)	$1,000/hole (hazardous only)	$1,000/hole (hazardous only)
CLP Analysis[3]	$3,000/sample	$1,200/sample	$1,200/sample
RI Report	$2,000,000	$46,000	$500,000
Total Project	$27,200,000	$500,000	$16,000,000

(1) Direct cost -- material and labor costs associated with doing the actual work. Indirect cost -- expenses that are not directly involved with material and labor of the work.

(2) Not included as part of statement of work.

(3) Full CLP analysis of nonradioactive water sample.

savings can be realized in the area of project management, particularly as more projects come on line. Another area of concern to the reviewers is the subtask of quality assurance (QA). The model allows for 40 hours per month of QA activity, with no explanation of what that activity is intended to accomplish. It appears that there could be a redundancy with the QA function, in that QA is also specified in other model elements, i.e., well drilling activities. The reviewers can not tell if this represents a duplication of effort. The model allows for $3000 per month for the 40 hours of effort. This would convert to a full time rate of $12,000 per month, based on a 160-hour work month. In comparison to the $9000 per month for engineering services, this rate seems high. DOE and WHC should closely evaluate this labor rate to see if it can be justified. If it can not be justified, DOE and WHC should take steps to adjust the rate accordingly.

2. SCOPING

2a. Assumptions Used in Model (See Page A1)
The scoping task was included in the RI/FS model to account for collecting information needed before RI field activities begin at each operable unit. The assumed subtasks include background investigation, report preparation, and field activities (e.g., air monitoring, radiation survey, and soil gas survey). The environmental engineering group provided an estimate for the background investigation subtask of 320 hours (2 people for 1 month based on a 160-hour month) at $18,000 ($9,000 per person). The $9,000-per-person rate includes a $7,000-labor rate and $2,000 for ancillary items (for example, travel and vehicle) (Wintczak, 1990c). The estimate for the field activities subtask included estimates from the environmental engineering group, the RPT group, and the NPO group (Wintczak, 1990d). The RPTs and NPOs will fulfill health and safety duties (radiation monitoring and decontamination). The cost estimates for RPT and NPO services are based on the rates specified by the respective labor unions, and assume that one RPT and two NPOs are on the job for a month. The RPT funding request of $13,000 per month covers items such as labor, equipment, equipment calibration and maintenance, vehicles, and support hours (Wintczak, 1990d). The Pacific Northwest Laboratories (PNL) and Kaiser Engineers Hanford (KEH) estimate for scoping field activities was based on historical costs for tasks such as air monitoring, soil gas survey, and geodetic survey. The environmental engineering group

estimated $27,000 (or a 3-person month) for the report preparation task.

2b. Model Applied to Cost Estimate for 200-BP-1

The scoping cost ($495,000) was generated in three parts. The first part was for the background investigation, calculated as $18,000 for one month (see Page A1). The second part was for field activities and was generated by using $150,000 monthly rate over 3 months. The third part, preparation of the scoping report, was estimated at $27,000 for one month. All scoping costs were derived directly from the model, with no adjustments made for the 200-BP-1 Operable Unit.

2c. Evaluation of Model and 200-BP-1 Cost Estimate

The reviewers were not provided with the documentation necessary to determine whether specific scoping costs were appropriate. The scoping budget should be refined to delineate the specific subtasks involved in the estimate. The anticipated field activities should be delineated to explain the estimated level of effort. For example, specify the assumed types of investigations and samples, the number of samples per investigation, and the number of man-hours required for each type of investigation. Scoping activities will understandably vary from one operable unit to another, thereby impacting costs. Costs will be impacted by the operable unit size, number and type of waste sites, and the extent of available existing information on the wastes and the sites. These factors should be considered in development of operable unit cost estimates, rather than adherence to the generic model values. These factors have been known for the 200-BP-1 Operable Unit for several months and should have impacted the scoping cost estimates. In fact, most of the scoping activity at this operable unit has been completed and incurred costs should now be available to update the trend system.

One specific observation in regard to scoping costs bears further discussion. The labor rate of $13,000 per month for an RPT should be justified. The reviewers assume that the labor union quoted this rate and that WHC has not asked for a detailed breakdown or justification, except as provided in 2a, above. It appears that the labor rate is excessive, even when overhead is included. The reviewers suggest that WHC pay particular attention to the areas of support hours and equipment in its review of this task.

One other element of the model appears to be of questionable value, when compared to the cost. The model (see page A1) provides for a Scoping Report that requires a level of effort of 480 hours and a cost of $27,000. The EPA and Ecology are working with DOE in an effort to eliminate or reduce extraneous process related activities; i.e., streamlining the RI/FS process. The scoping activities should result in a guide for direction into the RI/FS process at an operable unit. The documentation for scoping should be minimal and need not be formalized into a separate report. The scoping document can be a simple compilation of results that provides information to the authors of the RI/FS work plan. Data and information from scoping activities can be made available to the regulators via data base access, during unit manager meetings, and through other established lines of communication without creating a separate report.

3. PREPARATION AND REVIEW OF PRIMARY DOCUMENTS

3a. Assumptions Used in Model (See Pages A1 and A7 through A11)

The estimate for the work plan preparation and review was obtained from the environmental engineering group. The estimate was based on historical costs. Included in the task is 110 hours per month at a rate of $6,500 per month for a WHC review that includes 28 people (e.g., legal review and permits review) and 80 hours for review by the WHC engineer responsible for delivery of the document to DOE. This person essentially walks the document through the review process.

The cost-estimating model provides for an RI/FS work plan cost of $769,000 (assuming a contractor prepared document - see pages A1 and A2). Appendix D shows the incurred costs for work plan preparation and review up to the point of submittal to the regulatory agencies. The costs in Appendix D are for information only and can not be compared directly with the overall cost of RI/FS work plan preparation and review.

All primary RI/FS documents are estimated to allow a WHC subcontractor or EMO subcontractor to prepare the documents, in accordance with DOE's directive (Wintczak, 1990d). WHC assumes that preparation and review of RI Reports and FS Reports will require the same monthly level of effort as the work plan preparation and review subtasks. It should be noted that the RI Phase I Report is defined as a secondary document, rather than a primary document. However, WHC has deemed that its preparation and review will be equivalent to that of a primary document and is so reflected in the model.

The model provides the following time periods for report preparation and review, assuming a combination source and groundwater operable unit such as the 200-BP-1 Operable Unit:

Document	Preparation	Review
RI/FS Work Plan (initial)	7 months	10 months
RI/FS Work Plan (supplemental)	3 months	3 months
RI Phase I Report	14 months	6 months
RI Phase II Report	12 months	6 months
FS Phases I & II Report	10 months	6 months
FS Phase III Report	14 months	6 months

The six month review cycle for primary documents is set in the Tri-Party Agreement (Wintczak, 1990c).

3b. Model Applied to Cost Estimate for 200-BP-1

The primary documents considered in this section are the same as those mentioned in 3a, above. The monthly rates (hour and dollar) for document preparation and document review were used for each of these tasks. The monthly rate was either the EMO rate or the contractor rate (see page A1). Each task involved the completion of two reports. The bases for the costs for the respective document preparation and review tasks for the 200-BP-1 Operable Unit are shown in Appendix C.

The RI/FS work plan cost ($1,051,000) was obtained in two parts. The first part corresponded to the first phase of field work. The monthly document preparation rate of $57,000 (assuming a contractor and not EMO was doing the work) for seven months and the monthly document review rate of $37,000 (the contractor rate) for 10 months were used. The second part corresponded to the second phase of field activities. The same monthly rates were used but for a shorter duration (3 months for preparation and 3 months for review).

The costs for the RI Phase I Report and the RI Phase II Report tasks were estimated to be $1,020,000 each, for a total of $2,040,000. These estimates were generated using the same monthly rates and time frames. In a similar manner, the costs for the FS Phases I and II Report and the FS Phase III Report were estimated to be $1,020,000 each, for a total of $2,040,000. WHC based the costs for these report tasks on a monthly contractor document preparation rate ($57,000) over a 14 month duration for the first phase and over a 14 month duration for the second phase. Similarly, both tasks used the monthly contractor document review rate ($37,000) over 6 months for the first phase and over 6 months for the second phase.

3c. Evaluation of Model and 200-BP-1 Cost Estimate

The cost of preparing these documents appears to be excessive. In the private sector, it typically requires approximately 3,000 labor hours to complete the RI Report task. For example, PRC typically allocates approximately 2,000 hours (including clerical) for preparing an RI Report (this includes all phases). An additional 1,000 hours is usually estimated for the report review and report revisions.

Project-to-date data from 13 large RI/FS projects (greater than $800,000) were used to determine an average loaded labor rate of $137 per hour ($CH_2M$ Hill, 1986). This rate was obtained by dividing the total project dollars by the total hours. The rate is conservative when being applied to the RI Report task because other direct costs impacting the loaded rate are minimal for the RI Report task. An average loaded labor rate of $137 per hour over a period of 3000 hours for the RI Report task would result in a cost of $411,000. This estimate, when compared to the estimated $2,040,000 to complete the same task at Hanford, shows nearly a five fold difference.

The reviewers hold the position that this task should not require a substantially different level of effort at Hanford than is necessary in the private sector or at other federal facilities. In other words, the factors unique to radioactive or mixed waste must be considered, but will not impact report preparation and review costs by the same percentage as field activities.

It appears that following the various Hanford protocols accounts for a large portion of the abnormally high costs. An excellent example of this was given in an earlier section of this report, noting that these primary documents must be routed through a series of 28 separate individuals for signature. DOE and WHC must take necessary steps to streamline their "in-house" protocols to meet the needs of the Environmental Restoration program in an efficient, yet thorough manner. This is an area in which the regulatory agencies can not assist; DOE and WHC must take the lead. This streamlining must also carry through to other Hanford contractors such as PNL, KEH, and Hanford Environmental Health Foundation, as applicable, for consistency and to make a notable improvement in cost control.

Two areas of inconsistency were noted between the model assumptions and the printout for the 200-BP-1 Operable Unit cost estimate (Appendix C). First, the assumptions state that 12 months will be required for the RI Phase II Report preparation, yet the printout shows a duration of 14 months. Second, the assumptions state that 10 months will be required to prepare the FS Phases I & II Report, yet the 200-BP-1 Operable Unit printout shows 14 months. WHC was not aware of these discrepancies. WHC intends to review the model's assumptions and each operable unit cost estimate at the end of this fiscal year to eliminate such inconsistencies. It is most probable that the 200-BP-1 Operable Unit cost estimate will be modified; for example, the 200-BP-1 Operable Unit time frames will be adjusted to reflect the change in the model's assumptions (Patterson, 1990a).

The RI Report and FS Report preparation tasks included $3,000 per month for the WHC permitting group. This was an error since only during the work plan preparation task would the permitting group be involved. These costs, $84,000 per report preparation task, should be eliminated when the model is updated (Wintczak, 1990d).

Although the information is incomplete, Appendix D provides some basis for comparison of the RI/FS work plan preparation costs between the various contractors. DOE and WHC should consider why there is such variation in the costs and implement any necessary policy changes to arrive at the most efficient method of work plan preparation and review.

4. SITE CHARACTERIZATION AND NON-INTRUSIVE FIELD ACTIVITIES

4a. Assumptions Used in Model (See Page A2)
The site characterization and non-intrusive field activities lump sum estimate of $2,000,000 was formulated by assuming that a variety of investigations would be conducted under this task. During the interviews, WHC provided the reviewers with additional information on the subtasks, based on the following anticipated investigations and associated costs: (1) surface geophysics (e.g., metal detection surveys, ground penetrating radar surveys, electromagnetic surveys, seismic gravity surveys, electronic resistivity surveys) at a combined cost of $48,000 per

month for 10 months; (2) surface water and sediment sampling at a cost of $50,000 per month for 3 months; (3) surface radiation surveys at a cost of $54,000 per month for 10 months; (4) surveying and mapping (e.g., sampling grids, aerial photos, construct topographic maps, conduct vadose and groundwater well surveys) at a cost of $42,000 per month for 4 months; (5) biota surveys at a cost of $30,000 per month for 10 months; (6) air monitoring at a cost of $16,000 per month for 10 months; and (7) surface soil sampling at a cost of $20,000 per month for 10 months. The above mentioned subtasks comprise a conservative list and it should be noted that not every subtask would be proposed for every operable unit (Patterson, 1990a). The estimate includes data analysis and report preparation. The estimate was obtained from WHC's environmental engineering group and PNL (Wintczak, 1990c).

4b. Model Applied to Cost Estimate for 200-BP-1
This task cost ($2,000,000) was generated in two parts. Each part corresponded with the anticipated two phases of field activities, each at a cost of $1,000,000. These costs were obtained using the monthly rate of $100,000 for 10 months (see page A2). Costs were derived directly from the model, without consideration of operable unit specific conditions at the 200-BP-1 Operable Unit.

4c. Evaluation of Model and 200-BP-1 Cost Estimate
This lump sum estimate needs a greater level of detail to explain the level of effort required to execute each of the various subtasks. The model provides very little information about the various field activities and the documentation of subtask related costs.

At this time, all of the field screening activities related to the RI Phase I are to have been completed at the 200-BP-1 Operable Unit. Therefore, incurred costs should be available to WHC for use in updating the model and refining the overall cost projections for the RI/FS at the 200-BP-1 Operable Unit.

The reviewers are not convinced that the same level of effort for screening activities are necessary to support the RI Phase II that were necessary for the RI Phase I. The RI Phase I field activities were very important as very little was known about the operable unit prior to the start of the investigation. The advanced knowledge gained through these activities was of benefit to WHC prior to undertaking the full scale investigation. Also, it was critical to identify any possible worker health and safety concerns at that point. However, the RI Phase II is of a totally different nature. The majority of data gathering will have been accomplished during Phase I and a great deal of information will be available about the operable unit prior to the start of Phase II. Therefore, the reviewers do not believe that an equal level of effort for these preliminary activities (10 months of sustained activity at a rate of $100,000 per month) can be justified.

It was unclear whether the 200-BP-1 Operable Unit cost estimate included sampling of surface water and sediments. The general model assumption states that a monthly rate of $100,000 is necessary for field activities, exclusive of river sampling. If river sampling is appropriate for an operable unit investigation, such sampling is added at a cost of $50,000 per month, presumably over the entire 10-month period preceding the RI Phases I and II. However, the cost breakdown of this task provided to the reviewers included a surface water and sediment sampling subtask at a cost of $50,000 per month for 3 months. Although the total cost of the seven subtasks provided by WHC approximated the best engineering judgement cost in the model, the subtasks defined appear to be inconsistent with the model. Since the cost for these preliminary field activities at the 200-BP-1 Operable Unit was included at a rate of $100,000 per month (Appendix C), the reviewers could not determine whether surface water and sediment sampling had been included. The reviewers do not believe that such sampling should be included for operable units within the 200-Area, unless unique circumstances exist by which the sampling could be justified.

WHC should reassess the need and the level of effort for all of the preliminary field activities for RI Phase II. In addition, WHC should better define the subtasks to be done prior to Phase I. Documentation should be provided for the incurred costs for these activities over the period from October 1989 through July 1990. These costs should be evaluated and, as appropriate, used as input for the trend system. They should also be used to identify, refine, and support the specific budget needs for the 200-BP-1 Operable Unit RI/FS.

5. STAFF TRAINING AND STARTUP

5a. Assumptions Used in Model (See Page A2)
The training and startup task was included to provide funding for the training required to adequately staff (for example, RPTs, NPOs, samplers, and engineers) an RI/FS project. The estimate assumed that 6 months would be required for training new people. This estimate also allowed for a high labor turnover rate. This activity did not include update training for trained personnel; however, the cost for update training was factored into the funding requests from specific groups (for example, RPTs) (Wintczak, 1990b).

5b. Model Applied to Cost Estimate for 200-BP-1
The training cost ($432,000) was obtained using the monthly rate of $72,000 over 6 months (see page A2). Training costs for the 200-BP-1 Operable Unit RI/FS were derived directly from the model, without consideration to any operable unit specific conditions.

5c. Evaluation of Model and 200-BP-1 Cost Estimate
The model did not document the type of anticipated training to be done. The training level of effort should be justified by detailing the actual number of people expected to be trained, the types of training, and the number of hours necessary for each training activity.

The reviewers agree that staff training is a legitimate expense and should be accounted for in the budget estimate. However, without more specific information, the reviewers can not support the duration of training (6 months) for RPTs, NPOs, samplers, and engineers at a total expense of 1280 hours ($72,000) per month.

The issue of the number of hours required for one month of activity by an RPT was mentioned while describing the cost-estimating model in an earlier section. The RPT management have apparently now required that an RPT's time must be charged at a rate of 224 hours per month, rather than 160. The need for update training was used to justify the additional 64 hours per month The reviewers strongly question whether 40 percent of anyone's time can be justified for training purposes, particularly on a continuing basis. This is an area that should be closely evaluated and documented by DOE and WHC. If this level of training is required in union labor agreements and the level is deemed excessive by DOE and WHC at this time, it may be necessary to renegotiate such agreements at the earliest opportunity.

6. DRILLING ACTIVITIES

6a. Assumptions Used in Model (See Pages A3 and A4) The drilling activities task included two subtasks, (1) drilling preparation, and (2) drilling and sampling. Drilling preparation is a project management activity. The estimate included the level of effort required to prepare drilling documents (drilling specifications, radiation work permit, cultural resource reviews, excavation permit, and start card) and to ensure that proper documents are completed prior to the drilling activity. The WHC contractor and EMO funding was included to cover the cost of an oversight person to ensure that drilling plans are in accordance with the work plan. The cost for this task was obtained from the WHC drilling group (Wintczak, 1990d).

Estimates for drilling and sampling were provided by the WHC field services group and by KEH. The estimates assumed that all boreholes would be located in a radiation zone, and two rigs would be operating in separate exclusion zones. The estimate from the WHC field services group assumed that two RPTs and two NPOs would be required for drilling activities at each rig. One RPT would monitor in the exclusion zone and the other RPT would monitor outside the exclusion zone. The two NPOs would be required for decontamination activities. The WHC estimate also included quality assurance (QA), records support, and materials allocation. The QA level of effort was included to cover preparation of procedures and audits or surveillance activities. Records support funding included maintenance of project records and training records files. The materials allocation was for items such as casings and sample bottles. The KEH estimate was for the driller, the driller's helper for each rig, and operation and maintenance of the rigs. The WHC contractor and EMO also included estimates for one person to oversee the drilling operations to ensure compliance with the work plan (Wintczak, 1990b).

The assumed drilling rate was 10 feet per day for vadose boreholes and 20 feet per day for groundwater wells. This rate was based on typical cable tool drilling rates at Hanford. Most of the historical drilling has been done in the 200 Area (Wintczak, 1990e). The different rates were based on the assumption that more soil samples would be collected per foot for the vadose boreholes than for the groundwater wells (Patterson, 1990a). Collection of soil samples slows the drilling rate.

6b. Model Applied to Cost Estimate for 200-BP-1

The drilling cost was obtained assuming two phases of drilling activities, the RI Phase I and RI Phase II. Each phase entailed drilling preparation activities and actual drilling and sampling activities. The documentation requirements were assumed to be the same for each phase. Therefore the preparation task would be identical in each phase (i.e., $32,000 for 4 months). However, an assumption was made that the second phase actual drilling and sampling activities would only entail 60 percent of the first phase actual drilling activities. Therefore, the second phase would require a time frame that was 60 percent of the first phase time frame. The monthly rates for each phase would be the same ($193,000) (see page A3).

The drilling and sampling activity time frame was dependent on the number of waste management units or waste sites present at the operable unit. Appendix B contains the operable unit matrix, which is used to tailor the model to specific operable units. The 200-BP-1 Operable Unit was assumed to contain 11 waste sites (see page B2). The cost model's assumptions included installation of three new boreholes and one new groundwater well per waste site (see page A4).

Cable tool drilling was the assumed drilling method at a rate of 10 feet per day for vadose boreholes and 20 feet per day for groundwater wells. The duration for the Phase 1 vadose zone drilling activities at the 200-BP-1 Operable Unit was 4 months based on the assumptions that (1) the drilling rate is 10 feet per day per rig, (2) two rigs will be used, (3) a month is 160 working hours, (4) the number of vadose zone holes is 33 (3 holes x 11 waste sites), and (5) the depth of each vadose zone borehole is 50 feet.

Therefore, the Phase I drilling activity would be four months for vadose boreholes. The calculation for the vadose boreholes is based on the following:
-- 33 boreholes x 50 ft/borehole = 1650 ft;
-- 1650 ft at 10 ft/day/rig x 2 rigs = 82.5 days;
-- 82.5 days at 5 days per week = 16.5 weeks; and
-- 16.5 weeks at 4 weeks per month = 4 months.

Similar calculations were made for groundwater monitoring wells, except that drilling rates were faster (20 feet per day) due to less sample collection and the assumed well completion depth for the 200 Area was 300 feet. Therefore, the drilling duration for Phase I groundwater monitoring wells was 4 months.

The total Phase I drilling period was estimated to be 8 months in duration. The Phase II drilling period was estimated to be 5 months (60 percent of Phase I). The drilling cost was a total of the Phase I activities ($32,000 per month for 4 months and $193,000 per month for 8 months) and the Phase II activities ($32,000 per month for 4 months and $193,000 per month for 5 months).

Finally, the staffing required for drilling operations may be adjusted due to information gathered during the 1100-EM-1 Operable Unit RI operations. Economies of scale may be implemented by increasing the number of rigs and reducing the number of people used per rig by distributing personnel, as appropriate, between rigs. (The health and safety requirement was a minimum of 11 people for one rig (Cooper, 1990).)

6c. Evaluation of Model and 200-BP-1 Cost Estimate

The high drilling costs are a function of the number of people required for each rig and the rate (feet per day) at which a drill rig operates. These factors are discussed in this section.

The vadose zone underlying the 200-BP-1 Operable Unit is a fluvial deposit ranging in grain size from fine sand to granitic boulders in excess of 8 feet in diameter. The vadose zone boreholes and groundwater monitoring wells are to be drilled using cable tool drilling rigs, one of the slowest methods available for drilling boreholes. Other proven methods are available that may be able to drill boreholes of sufficient quality, and provide adequate safety standards, in as little as one-fifth the time. Reverse circulation air rotary drilling and ODEX drilling are two examples. The 200-BP-1 Operable Unit RI/FS Work Plan states that other drilling methods are being evaluated as alternatives to cable tool drilling. DOE and WHC acknowledge that selection of a faster technique that still meets all health and safety concerns will reduce the numbers of drilling hours, and thus, the costs.

Becker Drills, Inc. of Henderson, Colorado, was contracted to drill a test boring using the reverse circulation air rotary method at the Hanford site. Becker completed a water-table borehole (cased and screened) to 255 feet at an average penetration rate of 8.5 feet per hour. This included six to eight core samples (Ferris, 1990). The typical penetration rate at Hanford using cable tool drilling method is approximately 2.1 feet per hour (Brown, 1990). This rate does not include time for split-spoon sampling.

The potential cost savings that can be realized by use of a quicker drilling technique can be demonstrated by applying the model's drilling assumptions to a faster drilling rate. Table C-3 describes the estimated costs associated with drilling a 300-foot groundwater monitoring well at the 200-Area, within a radioactive zone. The number of personnel associated with the drilling task was obtained from the cost-estimating model (see Appendix A, page A3) and was held constant for each drilling technique. This rough analysis shows a cost savings in support personnel labor of over 70 percent (or $37,676 per well) by using a faster drilling rate. The drilling contractor costs, provided as a lump sum per month in the model, are not included in Table C-3 because the model did not differentiate between labor and materials for the drilling contractor subtask. The faster drilling rate would result in an unspecified savings in drilling contractor costs.

Another area which impacts drilling costs is related to the number of people assigned to the drill rig. The number of people involved and their work hours can not be ignored in terms of the speed of the drill rig, as shown in Table C-13. However, the type of disciplines required, the detailed subtask descriptions, and the number of people and level of effort necessary for each subtask, should be considered separately from the speed of the drill rig. The model does not provide sufficient detail for the reviewers to conclude whether the subtasks and the resource calculations to complete the subtasks were appropriate. As stated in previous sections regarding the cost-estimating model, further description of subtasks and justification for the level of effort proposed should be provided as part of the model. DOE and WHC should ensure that only the essential activities and personnel are included in the model.

One example of a subtask related to drilling that should be better defined is that of QA. This subtask appears to include an excessive level of effort. The 80 hours per month (40 hours per drill rig per month) for this activity is significantly higher than that experienced in the private sector. The level of effort equates to 25 percent of a QA specialist's time at each drill rig. In the private sector, when numerous RI/FS projects are managed by a single contractor, QA field audits are typically conducted at 10 percent of the RI/FS projects (Ruiter, 1990). The QA field audit pertains to all field activities, and is not restrictedto drilling. Forty hours are typically

TABLE C-3
COMPARISON OF SUPPORT PERSONNEL COSTS FOR DRILLING ACTIVITIES

Group	Labor Rate[1] Hour/Person	# People[1] @ 1 Rig	Labor Cost[2] /Hour/Rig	Cost/Well[3] Cable Tool	Cost/Well[4] Air Rotary
Team Leader	$55.83	0.75	$ 41.87	$ 5,024	$ 1,478
QA	$56.25	0.25	$ 14.06	$ 1,687	$ 496
Records	$75.00	0.06	$ 4.50	$ 540	$ 159
Sampling Scientist	$56.25	0.75	$ 42.19	$ 5,063	$ 1,489
RPT[5]	$56.25	2.0	$112.50	$13,500	$ 3,971
NPO	$56.25	2.0	$112.50	$13,500	$ 3,971
Health & Safety	$56.25	0.75	$ 42.19	$ 5,063	$ 1,489
Contractor	$75.00	1.0	$ 75.00	$ 9,000	$ 2,648
Total				$53,377	$15,701

(1) Calculated from p. A3 and adjusted for one drill rig.
(2) Labor rate/hour/person x # people @ 1 rig.
(3) Labor cost/hour/rig x 120 hours (2-1/2'/hour for 300' well = 120 hours).
(4) Labor cost/hour/rig x 35.3 hours (8-1/2'/hour for 300' well = 35.3 hours).
(5) RPT hours based on 160 hours/month, as per model, rather than on more recently quoted rate of 224 hours per month.

allocated for a full QA field audit of an RI/FS project. Depending on the timing of the visit, the audit of drilling activities may range from zero hours if no drilling is being done to 40 hours if drilling is the only activity occurring. The QA field audit does not necessarily include an evaluation of each well. This discussion may or may not be valid in the evaluation and comparison of QA activities in the model. However, this highlights the need, again, for WHC to provide a detailed description of the specific subtasks that are included in the model. Until that is done, neither a direct comparison to private sector costs nor an evaluation of the model can be made with any reasonable degree of certainty.

The model does not account for potential economies of scale that may allow key people to perform their tasks at multiple locations, (in this case, multiple drill rigs), thereby maximizing their efficiency. The reviewers assume that the model will be adjusted to reflect such efficiencies, to the extent realized from experience, as part of the trend system.

Incurred drilling costs from the 1100 Area RI/FS activities were reviewed to assess the accuracy of the cost-estimating model's assumptions (see Appendix D). The 1100 Area drilling operations were conducted as a characterization activity and a training session for personnel (i.e., radiation zone procedures were implemented to familiarize the staff with the procedures prior to conducting operations in a radiation zone) (Patterson, 1990b).

The drilling cost associated with the 1100 Area RI/FS activities, as of May 31, 1990, is $1,329,000 for 12 boreholes and 16 wells. The total drilling contractor's costs ($882,000) include drilling, installing the groundwater wells, abandoning the vadose boreholes, providing materials, and sampling (Patterson, 1990b). The field sampling cost was $176,000 as of May 31, 1990. By subtracting the field sampling costs from the drilling contractors' costs, the incurred costs for drilling and materials are $706,000. The drilling contractor's cost was calculated to be $482 per foot. This figure was reached by summing the drilling contractor's costs (KEH and WHC), then subtracting the field sampling costs and dividing the result by the total footage drilled. The $482 per foot rate includes drilling 28 holes, installing 16 groundwater wells, and abandoning 12 vadose boreholes. Health and safety and other supporting costs are added to this figure for a total drilling cost of $1,329,000.

The model predicts that the drilling duration for the 1100 Area would be approximately 4.5 months and the drilling contractor's cost would be $50,000 per month, including materials. The model assumes that abandonment of the vadose boreholes would take 1.5 months at a cost of $40,000 per month. The model's abandonment cost is then $60,000 for 12 boreholes. The model estimate for the drilling contractor, materials, and borehole abandonment at the 1100 Area is $285,000. This is significantly lower than the incurred costs for the drilling contractor at the 1100 Area.

Due to the apparent high cost of the drilling contractor at the 1100-Area (exclusive of other support personnel costs), the reviewers solicited an independent bid from a private sector company, for comparison purposes. This bid specified the ODEX drilling method and was based on other specifications, as follows, in an attempt to match the conditions at the 1100-Area as closely as possible.

- 12 boreholes to an average depth of 30 feet,
- 16 groundwater wells to an average depth of 72 feet,
- level B personal protection,
- 3 person drilling crew,
- 2-inch stainless steel casing, and
- construction materials and abandonment materials for borehole.

The estimated cost received from the drilling company was $200 per foot (High, 1990). This compares to the previously mentioned incurred drilling contractor cost of $482 per foot in the 1100-Area. It is important to note that this estimate does not include the time necessary for down-hole sampling using split spoons or coring methods or additional contingencies applicable to the Hanford Site. If sample integrity is a concern, and drill cuttings obtained using the ODEX method will not suffice for analytical purposes, then extra time and costs must be added to the estimate (about $50 per split spoon).

In addition, the cost incurred to drill and sample in protective level C or B may justify increasing the workday shifts to 10 hours because of the time involved in preparing to enter or exit the exclusion zones. The costs of the lengthened work shift should be calculated to determine whether any savings could be realized.

7. Borehole Abandonment

7a. Assumptions Used in Model (See Page A6)
The borehole abandonment estimate was based on the assumption that the abandonment task would occur over the same time frame as the vadose borehole drilling for a cost of $40,000 per month. The estimate was obtained from the WHC environmental engineering group and was based on historical costs. The estimate included a rig tender, driller, and materials and was based on the assumption that the entire borehole would be grouted to the land surface. No additional information was provided on this task.

7b. Model Applied to Cost Estimate for 200-BP-1
The borehole abandonment cost was generated using the monthly rate of $40,000 (see page A6) over the vadose borehole drilling duration. The 200-BP-1 Operable Unit estimate involved 4 months for RI Phase 1 activities and 3 months (approximately 60 percent of 4 months) for RI Phase 2 activities. Thirty-three boreholes are estimated for the 200-BP-1 Operable Unit.

7c. Evaluation of Model and 200-BP-1 Cost Estimate
Based on the information given, the reviewers believe that the assumed time frame for this task, as specified in the model and applied at the 200-BP-1 Operable Unit is excessive. The depth of shallow boreholes in the 200-BP-1 Operable Unit is approximately 25 feet. The deep borehole at each of the cribs is approximately 255 feet. The reviewers' experience in the private-sector would indicate that abandonment of a 25-foot borehole drilled using cable tool method should take approximately 4 hours for a 3-man crew to complete. Abandonment of the deep boreholes (up to 300 feet) should take a crew approximately 30 hours. Assuming 22 shallow wells and 11 deep wells at the 200-BP-1 Operable Unit, a total of 628 hours would be required for a 3-man crew to abandon all the boreholes. At 160 hours per month, this converts to approximately 4 months of activity for a crew, rather than the 7 months estimated in the model. This estimate does not include any mobilization and demobilization costs.

The model's cost for this task should provide a greater level of detail. For example, items such as (1) the cost of materials per borehole, (2) the manpower requirement for each borehole and a description for each person's assignment, and (3) the number of hours required for each borehole should be included. Once this information is available, a more thorough assessment of the costs can and should be made.

8. HAZARDOUS WASTE DISPOSAL AND DECONTAMINATION

8a. Assumptions Used in Model (See Page A4)
Hazardous waste disposal and decontamination estimates were developed using a set of assumptions that stem from the number of waste sites present at an operable unit. Hazardous waste disposal was estimated to cost $20 per foot for vadose boreholes and $5 per foot for groundwater wells.

Radiological decontamination is conducted at the T-Plant. The T-Plant is currently the only onsite facility equipped to handle radiological decontamination of heavy equipment. The T-Plant operations must be completely funded by current onsite activities. An assessment program is used to fund T-Plant operations. This assessment program entails evaluating expected work loads for the year and charging the corresponding projects a fee that will cover operating and maintenance costs. The RI/FS decontamination assumption is that radiological decontamination must be conducted after each hole is drilled at a cost of $18,000 per hole.

8b. Model Applied to Cost Estimate for 200-BP-1
The cost for this category ($1,326,000) is dependent on the number of waste sites present at the operable unit. This activity occurred in each of the field work phases.

A monthly rate was obtained by finding the total cost for RI Phase I and dividing by the number of months in Phase I (see Appendix B). The total cost for Phase I was generated in two parts. First, the $18,000 decontamination cost per rig was used for each of the holes drilled. For the 200-BP-1 Operable Unit, 44 holes will be drilled (33 vadose and 11 groundwater wells). Therefore, the total decontamination cost was $792,000 (see page B2). Second, the hazardous waste disposal cost of $20 per foot for vadose boreholes (total footage = 1,650 feet) and $5 per foot for groundwater wells (total footage = 3,300 feet) was used to obtain a total disposal cost of $50,000 (see page B3). The total Phase I cost was $842,000 (see page B4). A monthly rate was obtained by dividing the Phase I total cost by the Phase I drilling duration (8 months). The 200-BP-1 Operable Unit monthly cost was calculated to be $102,000 (see page B5).

The 200-BP-1 Operable Unit cost estimate used the monthly rate and applied it over the RI Phase I drilling duration of 8 months (disposal/decontamination occurs over the same time frame) and the RI Phase II drilling duration (5 months).

Due to significant costs, time, and paperwork associated with decontamination at T-Plant, temporary radiological and nonradiological decontamination facilities may be established adjacent to the work areas to expedite the decontamination process. A design study regarding the cost of constructing and operating such temporary decontamination facilities is currently being investigated (Wintczak, 1990b).

8c. Evaluation of Model and 200-BP-1 Cost Estimate
The level of detail for costs developed for this task is adequate. The high cost is apparently related to the costs assessed by the T-Plant ($18,000/borehole). This assessment cost should be validated and detailed by DOE and WHC to determine whether this cost can be justified.

Construction and use of temporary decontamination facilities in the proximity of the operable units could decrease decontamination costs. The advisability of pursuing this action should become clear as WHC completes its evaluation of this issue. The reviewers consider this a positive step in an attempt to reduce costs.

9. CHEMICAL ANALYSIS

9a. Assumptions Used in Model (See Page A5)
The estimate for analytical work was given by the onsite laboratories at a cost per sample. Chemical analysis refers to the soil samples taken while drilling the vadose boreholes and the groundwater wells. The average cost of $6,000 per sample for 200-Area soil samples was based on the assumption that 5 percent of the samples would require analysis in a hot cell at $18,000 per sample, 45 percent of the samples would require analysis in a hood at $8,000 per sample, and the remaining samples would only require routine nonradioactive analyses at $3,000 per sample (Wintczak, 1990c).

9b. Model Applied to Cost Estimate for 200-BP-1
As stated previously, this task includes the costs for analysis of subsurface soil samples obtained while drilling. The cost for this activity was generated by first using the operable unit matrix (Appendix B) and

obtaining a monthly analysis rate. The monthly rate was obtained using the model's assumptions, namely that 10 samples would be collected for each hole drilled. Sample analysis costs were $6,000 for soil samples from vadose boreholes and $3,000 for soil samples taken during groundwater well drilling (see page A6). The matrix is used because the number of waste sites varies at each operable unit. The 200-BP-1 Operable Unit was assumed to have 11 waste sites. Therefore, the total cost for chemical analyses during the RI Phase I was calculated as $2,310,000. The monthly rate was determined to be $280,000 (see page B4), which is approximately the total RI Phase I cost divided by the RI Phase I drilling duration (8 months). This monthly rate is actually rounded down from $288,000 by WHC.

The monthly rate of $280,000 was entered into the model and distributed over the RI Phases I and II drilling time frames (8 months and 5 months, respectively) to generate the total cost of $3,640,000.

9c. Evaluation of Model and 200-BP-1 Cost Estimate
The costs developed for this task are sufficiently detailed. The assumptions on the number of samples and types of analyses appear to be reasonable. This is an area that should be refined by use of the trend system as incurred cost information becomes available. The high cost is a function of the individual sample analysis cost. These soil sample analysis costs should be more detailed and validated. Further discussion on laboratory analytical costs for Hanford work is included in another section of this report and will not be addressed further in this section.

10. PHYSICAL ANALYSIS

10a. Assumptions Used in Model (See Page A7)
The physical analysis (i.e., soil hydraulic characterization) task estimate was based on engineering judgement. WHC anticipated that soils contaminated with radionuclides would have to be analyzed in a protective environment (i.e., hood or hot cell) depending on the radiation level and this was reflected by higher costs in the model (Wintczak, 1990a). Incurred costs for the physical analysis of nonradiological samples were not available at the time this model was generated (Patterson, 1990b).

10b. Model Applied to Cost Estimate for 200-BP-1
The physical analysis cost ($350,000) was generated using the $50,000 monthly rate over the RI Phase I vadose drilling duration (4 months) and the RIPhase II vadose drilling duration (3 months).

10c. Evaluation of Model and 200-BP-1 Cost Estimate
A greater level of detail for this task should be provided to justify the costs used in the model. The number and types of soil characterization analyses, and the cost per analysis should be documented. The reviewers asked for a more specific breakdown of subtasks, but WHC was unable to provide this information. For this reason, comparative costs for physical analysis outside of the Hanford Site can not be made by the reviewers.

11. Groundwater Monitoring

11a. Assumptions Used in Model (See Page A7)
The groundwater monitoring estimate was based on engineering judgement and applies only to monitoring of newly installed wells. The assumptions were (1) monitoring would begin at the initiation of groundwater well drilling and continue through the ROD, and (2) one sample per newly installed well per quarter would be collected and analyzed at a cost of $2,000 per nonradioactive sample. The estimated number of groundwater wells was dependent on the number of waste sites identified at the operable unit, i.e., one new well per waste site. The $2,000 per sample rate was obtained from PNL's sample management office who contacted private laboratories to obtain the quotes (Patterson, 1990a).

11b. Model Applied to Cost Estimate for 200-BP-1
The total cost for the groundwater monitoring task ($759,000) was obtained by first generating a monthly rate. The monthly rate was generated from the model's assumptions that one sample per newly installed well per quarter would be collected and analyzed at a cost of $2,000 per sample. The 200-BP-1 Operable Unit assumption was that 11 groundwater wells would be installed. Therefore the monthly rate was $7,000 for Phase I RI (11 wells x 1 sample per quarter x 1 quarter per 3 month x $2,000 per sample = approximately $7,000 per month) and $15,000 for RI Phase II. The reviewers have assumed that Phase II monitoring costs for the 200-BP-1 Operable Unit were increased to account for monitoring of additional wells to be drilled in Phase II. In this manner, wells drilled during both RI Phases I and II would be monitored at a total monthly

cost of $15,000. If the reviewers' assumption is correct, more wells would have to be drilled in RI Phase II than in RI Phase I, to account for this additional cost.

11c. Evaluation of Model and 200-BP-1 Cost Estimate
The model's cost of $2000 per nonradioactive sample is consistent with costs incurred at other Superfund sites. However, many of the samples from Hanford will contain radioactive constituents (e.g., tritium, technetium, and strontium), for which no cost estimates were provided in the model. Further, the cost of $2000 per sample applies only to laboratory costs, not to sample collection. Due to the number of people present during sampling, it is very possible that the sampling cost could be higher than the analytical costs per sample. WHC should account for analysis of radioactive groundwater samples and for sampling costs to refine this portion of the model.

Analytical costs are a function of the number of samples and the type of analyses. The typical cost for organic and inorganic CLP analyses is $1,000 to $1,200 (see Table C-2). Laboratories that perform radiochemical analyses are limited. It is important to note that most commercial laboratories can not accept samples that have a radioactive component (greater than 1 mR per hour), and the price does not cover the cost of sample shipment from Hanford.

WHC and DOE have proposed that existing wells be used as part of the RI/FS wherever possible, in an effort to reduce costs. The reviewers agree that the use of existing wells for appropriate purposes, based on data quality objectives, is prudent. Therefore, the groundwater monitoring costs should be based on the total estimated number of wells used to support the RI/FS, rather than just the new wells to be installed. The cost of monitoring (sample collection and analysis) has little to do with whether the well is newly installed or existing. Installation of 11 new groundwater monitoring wells was estimated and budgeted for the 200-BP-1 Operable Unit RI/FS. The RI/FS work plan provides that additional existing groundwater monitoring wells would be used as part of the monitoring network. Monitoring costs should be estimated on the total number of wells included in the monitoring network.

Finally, the reviewers do not agree that the groundwater monitoring costs should more than double ($7000 versus $15,000) due to additional wells installed under the RI Phase II. Phase I drilling activity lasts for 8 months, while Phase II drilling lasts for only 5 months. Phase II drilling activity was originally planned as a time to conduct any necessary treatability investigations and to supplement data collection needs. Drilling of more wells during Phase II than during Phase I was never anticipated. While this scenario is possible, based on operable unit specific conditions, it should be considered the exception rather than the rule. WHC should reassess the basis for the $15,000 per month groundwater monitoring cost during and after the RI Phase II, and either provide detailed documentation for this cost or adjust the cost in the model.

12. PERFORMANCE ASSESSMENT

12a. Assumptions Used in Model (See Page A11)
This task involves determining the potential fate and transport mechanisms for contaminants present at the operable unit and evaluation of the associated risks. The estimate for this task was based on engineering judgement. The engineering judgement involved the number of man-hours necessary to complete the task. The task was divided into two phases. The assumptions were that approximately 1.5 staff members were necessary for the first phase and 2 staff members were necessary for the second phase. The first phase was estimated to take 24 months and cost $360,000. The second phase was estimated to take 12 months and cost $240,000. The manpower requirement was increased in the second phase based on the assumption that there would be more data to process during the second phase (Patterson, 1990). Unresolved issues that could affect the cost associated with this task include the determination of future land use, the expected point of compliance, and the allocation of risk method (i.e., per operable unit or per entire site).

12b. Model Applied to Cost Estimate for 200-BP-1
The performance assessment cost ($600,000) was generated using the Phase I and Phase II monthly rates ($15,000 and $20,000, respectively) over the assumed time frames for each Phase (24 months and 12 months, respectively) (see page A11).

12c. Evaluation of Model and 200-BP-1 Cost Estimate
The cost for this task should be more detailed in order to justify the overall level of effort that was estimated for this task. The subtasks were not well defined; therefore, the reviewers were unable to evaluate the adequacy of the cost estimates or to

compare the estimates to private sector work for similar tasks. However, the reviewers were able to draw some conclusions regarding performance assessment. First, the model does not account for deletion or reduction in performance assessment activity after the first several RI/FS projects have been completed. Continuation of tasks such as development of models and establishing site-wide background data at a high level of effort (5 man-years) can not be justified at every operable unit.

Second, the model does not consider the difference between source operable units, groundwater operable units, or combination (source and groundwater) operable units. The level of effort for performance assessment activity as it relates to these different types of operable units should vary considerably.

The third area is not directly related to cost, but has to do with management. The reviewers noted during recent Unit Manager meetings that the WHC group who has responsibility for performance assessment on a site-wide basis has very little to do with input to or review of the various RI/FS work plans as they are developed. While the performance assessment group's role is broader than RI/FS work, the reviewers believe that the performance assessment group should be closely tied to the engineering group and should be involved at the operable unit RI/FS level. This would facilitate better communication, minimize surprises, and, hopefully, have some degree of positive impact in cost reduction over the long term.

13. TREATABILITY STUDIES

<u>13a. Assumptions Used in Model</u> (See Page A11)
The treatability study estimate was based on engineering judgement. The $3,000,000 estimate was going to be built into 10 RI/FS projects and then this cost would be eliminated from future RI/FS activities based on the assumption that the studies would be applicable for a wide range of operable units (Wintczak, 1990c).

<u>13b. Model Applied to Cost Estimate for 200-BP-1</u>
The treatability study task cost ($3,000,000) was generated by distributing the total cost over the assumed time frame. It was assumed that the middle months of the time frame would require a greater level of effort than the beginning or ending months. Therefore the distribution is not evenly distributed over the entire time frame.

13c. Evaluation of Model and 200-BP-1 Cost Estimate
Planning for treatability studies prior to initiation of scoping or investigation activities is a difficult task. Likewise, a budget estimate for these activities which is prepared over two years in advance is likely to have a low degree of confidence. The reviewers do not disagree with the cost estimate or the assumption in the model, but do have one suggestion. A generic list of all potential subtasks should be defined, with an estimated or documented level of effort for each of the subtasks, including a breakdown by personnel required to complete the task. If this were done on a site-wide basis, WHC could make an "educated guess" on which subtasks, if any, were likely to have applicability at an individual operable unit. Certainly, this is an area where the trend system will be useful in determining applicability at future operable units and in updating the model based on incurred costs.

14. ENVIRONMENTAL ASSESSMENT

14a. Assumptions Used in Model (See Page A11)
The DOE has determined that the National Environmental Policy Act (NEPA) applies to CERCLA activities at its various sites, including Hanford. Therefore, to comply with NEPA, WHC assumed that an environmental assessment would be done for every unit, including the 200-BP-1 Operable Unit. The WHC regulatory / NEPA permitting group provided the estimate of $1,000,000 based on engineering judgement (Wintczak, 1990c). No other information was provided to justify this cost.

14b. Model Applied to Cost Estimate for 200-BP-1
The environmental assessment cost was generated by distributing the lump sum cost over the assumed time frame (18 months). The 200-BP-1 Operable Unit distribution consisted of 15 months at $50,000 per month and 3 months at $100,000 per month. The higher level of effort for some months is based on the assumption that at the beginning of the assessment more data will have to be compiled before the assessment can begin. This distribution for 200-BP-1 Operable Unit results in a total cost that is $50,000 above the model's assumed lump sum of $1,000,000.

14c. Evaluation of Model and 200-BP-1 Cost Estimate
From a cost evaluation standpoint, the estimate for this task should be more detailed to justify the overall level of effort that was assumed. A breakdown by subtask is also needed. Although there is presently

insufficient information for the reviewers to evaluate WHC's estimate, the cost of $1,000,000 per operable unit seems inordinately high.

From a cost saving standpoint, the EPA Region 10 maintains its position that DOE does not need to implement the NEPA process at each operable unit. Elimination of this activity will save approximately $78 million, based on WHC's current cost estimate and the number of operable units at Hanford. EPA believes that the administrative process under CERCLA is functionally equivalent to that of NEPA, with the exception of assessing cumulative impacts on a site-wide basis. The reason that cumulative impacts will not be assessed under the CERCLA process at Hanford is that EPA does not believe that a valid assessment can be made without operable unit specific information. Under CERCLA, this information will be collected for each operable unit and assimilated for the Hanford Site, as specified in the <u>Hanford Federal Facility Agreement and Consent Order</u>. EPA requests that DOE reconsider its position on NEPA implementation at the Hanford Site and decide on a course of action that uses available funding for environmental restoration in the most efficient way possible.

6. SUMMARY AND CONCLUSIONS

This section consists of a discussion of some of the factors which are unique to Hanford and impact costs, a general comparison of overall costs to the costs encountered in the private sector, and general conclusions.

A. Factors Unique to Hanford

The most obvious and perhaps the major complication at the Hanford Site is the fact that the site is contaminated with radioactive materials. The handling of potentially radioactive materials requires specially adapted procedures to minimize the potential for worker contact and to reduce contaminant migration during field activities. The two major areas impacted by the radioactive component during the RI/FS are the field investigative work (namely, drilling and sampling) and sample analysis costs. For example, the number of personnel required for drilling operations is elevated to provide a higher degree of monitoring and protection. Another example is the extensive documentation and multiple approvals required for transporting samples (for example documentation includes, chain-of-custody, analysis request, offsite control form, hazardous material shipment record, radioactive shipment record).

The Hanford Site is evolving from a nuclear production facility to an environmental restoration and research and development facility. There are large operations onsite that must be funded through the new operations. Examples of these operations are the laundry system, the busing system, site regulatory personnel, and the various craft personnel. Also, the transition to the environmental restoration program entails a degree of startup costs. As onsite personnel receive training on the program-specific requirements, the startup factor should dissipate.

The operations at Hanford occur under the directive of DOE. Therefore, the operations conducted at the site must meet with the DOE policies and terms of various labor agreements that may impact costs. For example, if onsite work requires personnel protection level A for welding, a member of the pipe fitters union must be included in the work party to attach airlines. In addition, the radiation survey and equipment decontamination tasks must be conducted by a member of the RPT union or NPO union, respectively. Laundry (cleaned coveralls) must be delivered to the work site by a laundry union member. The union's management is also funded at a level necessary to provide requested support.

B. Private Sector RI/FS Cost Comparison

Numerous comparisons to specific project elements have been made in the preceding pages. This section provides two brief comparisons to overall RI/FS costs outside of Hanford. Caution must be used when comparing costs from different investigations. As noted previously, Hanford has distinct characteristics that impact costs (as do all other sites). Thus, the size and complexity of the site, the nature and extent of contamination, and the environmental surrounding must be considered when evaluating costs. A comparison of selected costs at Hanford with private-sector costs was previously shown in Table C-2.

A recent cost estimate for an RI/FS project at a U.S. naval installation quoted a total cost of approximately $16,000,000. However, this figure does not include RI/FS work plan preparation or scoping. The cost does include all investigative and reporting activities up to the finalization of the RI Reports. The investigation involved three operable units that included 6 installation restoration sites including industrial landfills, oil reclamation ponds, scrap yards, old transformer storage yard, and submarine base area. Seven million dollars were allocated for anticipated chemical analysis. Three final RI Reports are estimated to cost a total of about $500,000.

A small RI/FS project (total cost about $500,000) at the Foldertsma Refuse NPL site in Michigan that was approximately 70 percent complete as of April 1990 has incurred costs of $19,000 for scoping; $28,000 for work plan (including QA project plan) preparation; $110,000 for soil and sediment sampling (including drilling); $11,000 for groundwater sampling; and $46,000 for project management. The percent distribution for these tasks are 6 percent, 8 percent, 32 percent, 3 percent, and 14 percent, respectively. These percentages approach "typical" task distributions. Once again, the comparison between project budgets should be conducted with great caution.

C. General Summary and Conclusions

The EPA evaluated the 200-BP-1 Operable Unit cost estimate generated by WHC. This cost estimate was developed as an order-of-magnitude estimate prior to finalization of the 200-BP-1 Operable Unit Work Plan. The total estimated cost for this project is $27,200,000. This estimate was generated by a computer model that used a set of general conservative assumptions.

The level of documentation explaining the basis for the model's estimate should be developed in greater detail. DOE's cost-estimating handbook specifies that an explanation of how the estimate was developed should be written for each task. This explanation should include a task description, project work breakdown structure, summary task schedule, basis of the cost estimate, and escalation (DOE, 1990). The trend system that is in place will provide a degree of documentation.

The model is expected to undergo modifications that will reflect the information acquired over the previous fiscal year. A review of the modified model may provide missing information and give an indication of the effectiveness of the trend system.

The assumptions used to develop the cost-estimating model appear to be conservative, yet can not be confirmed as to their reasonableness based on the level of the estimate, the various unknowns present during estimate preparation (i.e., scope of work), and the special considerations that are associated with the work at Hanford. Some areas of concern involve the level of effort estimated to produce a report and to conduct field activities. The funding necessary to complete these tasks may be reduced by refining the level of review and documentation required, such as the 28-person WHC review for primary documents. These decisions must be made in-house and require a re-evaluation of established procedures.

Private-sector RI/FS cost information is provided, but caution must be used when comparing the costs to the Hanford estimates. Site-specific and investigation-specific characteristics that impact costs are not obvious from bottom-line cost quotes. Work at Hanford must contend with a variety of special features including radioactive contamination, an established network of contractors, and DOE and contractor requirements. Similarly, the estimates used for comparison purposes may be impacted by other cost impacting features.

A discussion of the loaded hourly rate for RI/FS work is provided here to clarify the basis for some of the costs. For the most part, the percent distribution of labor costs per task is comparable between private-sector RI/FS costs and Hanford's model estimated costs. The loaded hourly rates are also similar (200-BP-1 Operable Unit rate is about $105 per hour is lower than the private-sector rate of $137 per hour). It is important to note that the 200-BP-1 Operable Unit lower loaded hourly rate may be an indication of labor inefficiency (i.e., labor cost to material cost ratio is higher for 200-BP-1 Operable Unit work than for private-sector work).

The 200-BP-1 Operable Unit loaded rate was calculated using only the tasks that were assigned a labor hour breakdown in the estimate assumptions (i.e., scoping, work plan, training, drilling preparation, drilling, RI Report, FS Report, and management) and the tasks that EPA assumed had minimal labor hours associated with them (i.e., sample analysis, hazardous waste disposal and decontamination). The total labor hours were 190,684 and the total cost associated with these tasks was $20,037,000. The labor hours equate to about 15 people working full time over six years. The 15 people are for the tasks delineated above. Other tasks that will include additional staff are site characterization and non-intrusive field activities, borehole abandonment, physical analyses, groundwater monitoring, performance assessment, treatability studies, and environmental assessments. Using the $105 per hour rate, the number of full-time personnel working on these tasks for six years would be six. Therefore, it appears that 21 people are expected to work full-time for six years on this project. This level of labor appears to be excessive, based on the reviewers' experience with other Superfund sites.

In summary, the level of detail forming the basis of the cost-estimating model should be refined. For example, breakdown of man-hours required for each task should be established. Also, a task description should be provided that gives enough detail to explain the staffing requirements for each task and the anticipated time frames.

D. 300-AREA PROCESS WATER TREATMENT PLANT

1. BACKGROUND

The 300-Area currently produces approximately 1200 gallons per minute (gpm) of process water containing inorganics, organics, and trace amounts of radionuclides. Presently, this water is fed into two process trenches that use percolation into the soil column as the process water disposal method. In response to a Congressional request, the Department of Energy (DOE) published the annual "Plan and Schedule" in March 1987 (updated in September 1988 and September 1989) to discontinue disposal of contaminated waste streams in the soil column at the Hanford Site. This schedule was adopted into the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) in May 1989. The 300-Area process water stream was listed as a high priority stream for treatment and eliminating discharge. The Tri-Party Agreement schedule requires cessation of discharge of this stream by December 1991 and completion of a 300-Area treated effluent system by June 1995.

In response to DOE's requests in the Plan and Schedule, Westinghouse Hanford Company (WHC) proposed constructing a water treatment plant to treat all of the 300-Area process water. The initial treatment plant design (from here on referenced as the $39M design), prepared by Kaiser Engineers Hanford (KEH), assumed a 1200-gpm process flow and was estimated to cost $39,500,000. DOE did not approve this initial design and, as a result, KEH prepared another treatment plant design that assumed a 300-gpm process flow. The cost of this design was approximately $15,000,000 (from here on referenced as the $15M design). The $15M design is contingent on WHC's and Pacific Northwest Laboratories' (PNL) ability to reduce process effluent flow at the 300-Area from 1200 gpm to 300 gpm.

The reviewers considered both the $39M and $15M designs to determine if both were feasible and whether the $39M design should be further considered in order to treat the stream sooner, (i.e., concurrent with any waste minimization activities). Additionally the reviewers wanted to identify if it was feasible to use the larger design system to treat contaminated groundwater produced during anticipated remedial actions in the 300-Area. The primary documents reviewed in EPA's investigation were the Conceptual Design Reports (CDR) for both the $39M and $15M designs and the Functional Design Criteria prepared by WHC.

It should be noted that, during this review, the \$15M CDR was undergoing a concurrent review by WHC. The final CDR was accepted by DOE on June 8, 1990. The reviewers have not considered the design changes that were included in the final CDR as part of this evaluation, since they had gathered the majority of information and had begun assessing the information prior to that date. Changes in the final CDR resulted in cost savings in some areas and increased costs in others. The overall cost for the treatment plant, \$14.7 million, remained constant in both the draft CDR and the final CDR.

2. DESCRIPTION OF DOE'S PROJECT COSTS

DOE did not approve the \$39M design because of its high cost. Subsequently, KEH reevaluated the design basis for the 1200-gpm plant, for the purpose of reducing costs. The modified design was based on the assumption that the inflow stream would be reduced from 1,200 gpm to about 300 gpm. This flow reduction was to be accomplished by excluding certain cooling water streams and adopting area-wide waste minimization. By reducing the flow rate to 300 gpm and eliminating the holding basins, the cost estimate of the treatment plant was reduced to \$14.7 million, (i.e., the \$15M design). In addition, the measures to implement waste minimization measures, necessary to achieve the 300 gpm flow rate, were calculated to be \$6.3 million. The development of this option followed essentially the same procedures as the 1200-gpm option. This consisted of revisions to the Engineering Study, Functional Design Criteria, and the Conceptual Design Report. WHC and DOE reviewed and approved each of these reports.

DOE-Richland (DOE-RL) considered a third option, but abandoned it after developing detailed cost estimates. This option called for diverting flows from the 300-Area to the City of Richland's wastewater treatment facility. After extensive negotiations, the City's assessment fee was set at \$20.4 million. In addition, a \$1.7 million sanitary sewer connection fee was specified and waste minimization activities were required, at a cost of \$6.3 million. Because of the high cost, this alternative was dismissed in favor of the \$14.7 million alternative with additional \$6.3 million allocated for waste minimization.

It should be noted that the cost of discharging treated effluent was not considered in the cost estimates for the \$15M and \$39M designs. The reviewers assume that this discharge would require either a National Pollutant Discharge Elimination System (NPDES) permit or a state 216 discharge permit. Likewise, the cost of complying with pre-treatment requirements under the option of tying into the City of Richland's treatment plant was not calculated. A summary of the options which DOE-RL considered and their respective costs are presented in Table D-1. The feasibility of the $15M water treatment plant design depends on the ability of WHC and PNL to reduce process water flow from the 300-Area to 300 gpm. It should be noted that the process flow reduction plan is estimated to cost $6,260,000 (rounded to $6.3 million), which is not included in the estimate for the $15M design. Therefore, the total cost of a 300 gpm treatment system, as currently planned by DOE, will be $21 million.

The $39M water treatment plant was designed to accept 300-Area process water at a rate of 1200 gpm. However, only 300 gpm maximum was to actually undergo treatment; the remaining 900 gpm would have been discharged to the Columbia River without treatment. This discharge was contingent on the water meeting applicable permit specifications such as an NPDES permit. Thus, both the $39M and $15M designs allow for a 300-gpm water treatment system, but the $39M design diverts 75 percent of its incoming flow to the Columbia River. The additional $24 million associated with the $39M design is primarily attributed to constructing five 2.8 million-gallon retention basins used to retain the untreated process flow until it could be sampled, analyzed, and shown to meet discharge limits prior to release into the Columbia River.

The $39M and $15M designs use similar water treatment process equipment and follow the same process flow structure. Figure D-1 provides a process flow diagram for the $15M design. The $39M design's process equipment is similar to that shown in Figure D-1 with the exception that an electrodialysis reversal (EDR) unit rather than a reverse osmosis (RO) unit is used in the $39M design. In addition, the $39M design uses filtration, ion exchange, and evaporator systems that are of different design than in the $15M design.

The first stage in the treatment process for both designs is suspended solids removal using filtration. The $15M design uses a multimedia filter and the $39M design uses a bag filter for removing particles to preclude plugging or fouling of downstream equipment. The second stage of both designs consists of organics

TABLE D-1
300-AREA PROCESS WATER TREATMENT FACILITY
-OPTIONS AND COSTS-

Option	Cost
High Flow System (1200 gpm)	\$39.0M
Low Flow System (300 gpm)	
Facility	\$14.7M
Waste Minimization	\$ 6.3M
Total	\$21.0M
City of Richland Sewer Connection	
Assessment Fee	\$20.4M
Waste Minimization	\$ 6.3M
Sanitary Sewer Connection	\$ 1.7M
Total	\$28.4M

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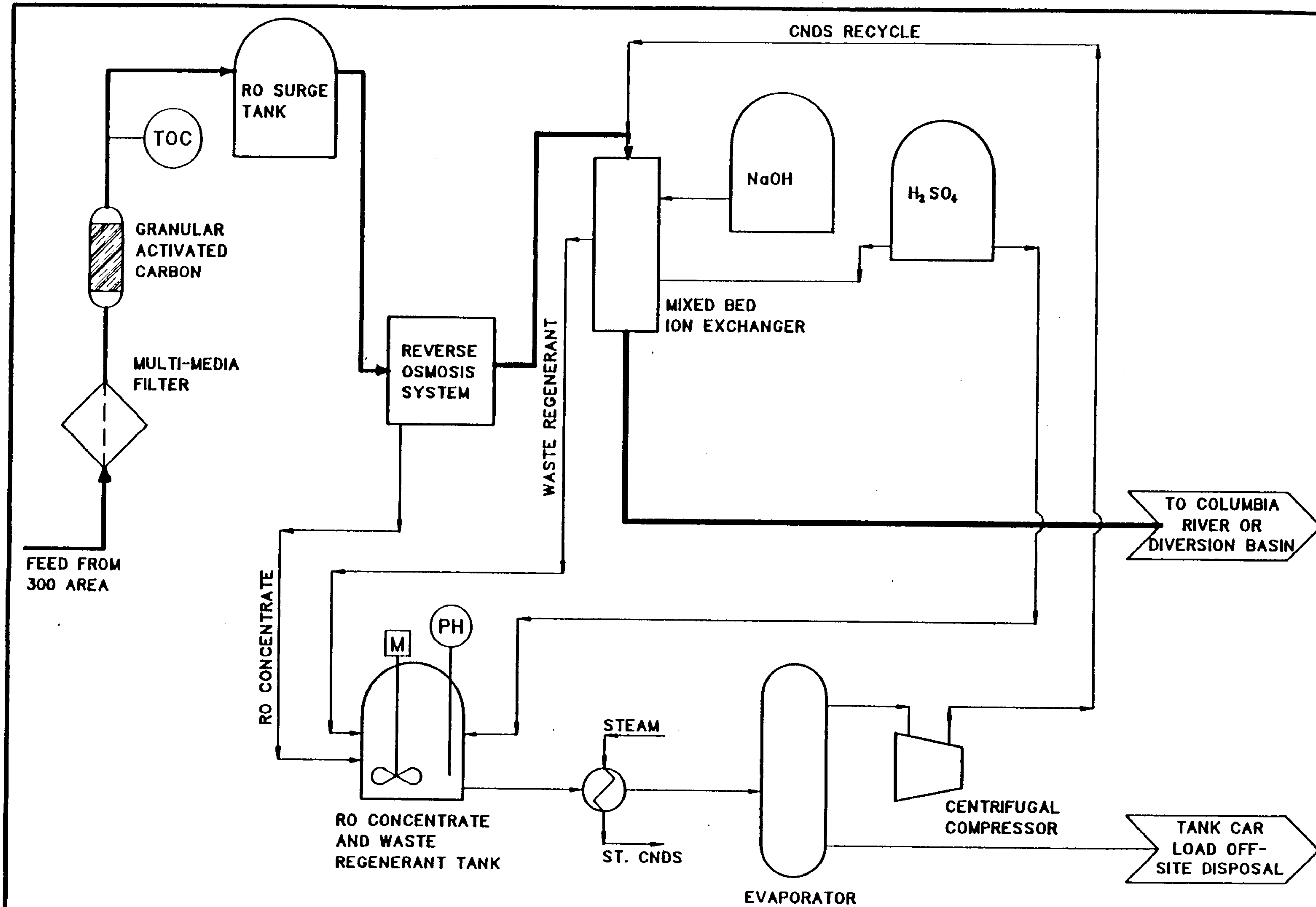

FIGURE D-1
$15M DESIGN PROCESS FLOW DIAGRAM

SCALE: NOT TO SCALE

removal using a granular activated carbon (GAC) system. Switch over to a standby GAC vessel occurs automatically when organic breakthrough is detected by a total organic carbon monitor. The third stage of treatment is inorganics removal. The $15M design uses RO as pretreatment for an ion exchange system which follows. The $39M design uses EDR as pretreatment for an ion exchange system. Both EDR and RO serve to remove the majority of the inorganic constituents in the influent by use of membrane filtration. The ion exchange polishers remove most of the remaining inorganic constituents not removed during pretreatment. The final stage of treatment in both designs is liquid waste minimization through an evaporator unit.

A summary of the process equipment used in each design for each stage of treatment is provided in Table D-2. Process equipment required for the $39M design, but not the $15M design, includes: neutralizer ($110,000), waste slurry dewaterer ($32,000), and resin disposal casks ($175,000). The total process equipment cost (not including labor, escalation, and contingencies) is $2,300,000 for the $15M design and $3,150,000 for the $39M design. As indicated in Table D-2, the general structures of the two designs are similar. Process equipment costs for the $15M design, however, are substantially less.

WHC will be responsible for overall project management. Duties include interfacing with DOE, supervising KEH, and preparing the safety analysis report (SAR), quality assurance plan, and project management plan. The design and construction of the water treatment plant will be performed by two contractors. KEH will perform the definitive design, engineering and inspection, procurement, and construction for the tie-in to the existing sewer line, sump 1, and new piping through the contaminated area along the existing crib. An offsite design and construction contractor (D/C Contractor), yet to be determined, will perform all design, inspection, and construction for the water treatment plant, retention basins, sumps (other than sump 1), valve pits, and interconnecting piping. KEH is also responsible for managing the D/C Contractor.

Table D-3 provides a cost breakdown for the treatment plant. This table summarizes costs developed in the CDR (see Appendix E, page 2 of 10).

TABLE D-2
PROCESS EQUIPMENT COMPARISON

First stage -- suspended solids removal

	$15M	$39M
Filter	Multimedia Filter	Bag Filter
Capacity	Unknown (assumed 300 gpm)	400 gpm
Particle Size Removal	10 microns	5 microns
No. of Filters	2-Filter System/Standby	Same
Cleaning/Changeout	Period Backwash	Periodic Bag Filter Media Changeout
Cost	$100,000	$20,000

Second stage -- organic contaminant removal

	$15M	$39M
Beds	Two 10-ft-dia vessels 715 cft of carbon	Same
Capacity	Unknown (assumed 300 gpm)	350 gpm
Changeout	Complete bed changeout from off-site supplier	Fresh carbon introduction system
Regeneration System	None	None
Additional Organic Removal	None	Air Stripper $50,000
Cost	$200,000	$250,000

TABLE D-2 (continued)

Third stage -- inorganic contaminant removal

	$15M	$39M
Pretreatment Unit	Reverse Osmosis (RO)	Electrodialysis Reversal (EDR)
Capacity	Unknown (assumed 300 gpm)	500,000 gpd (approx. 347 gpm)
No. of Stages	3	Unknown
Concentrate Steam Recovery	10%	Same
Dissolved Ion Removal	95%	90%
Final Treatment	Ion Exchange (IX)	Same
No./Type of Columns	2/Mixed Bed Polishing, Regenerable	3/Treatment and 2/Polishing, Nonregenerable
Cost	$637,000	$900,000

Fourth stage -- secondary waste treatment, evaporator unit

	$15M	$39M
Basic Components	Evaporator with crystallization ability	Same without crystallization ability
Capacity	Unknown (assumed 30 gpm)	40 gpm
Concentrate Waste Solutions	2% solids to 80%	1.5% solids to 35%
Further Dewatering Required	No	Yes
Cost	$1,500,000	$1,000,000

TABLE D-3
COST BREAKDOWN -- 300 AREA PROCESS WATER TREATMENT PLANT

CONTRACTOR	DESCRIPTION	MATERIALS, LABOR & OH&P/B&I ($)	OTHER DIRECTS (ADMINISTRATION) ($)	ESCALATION (6.88-13.81%) ($)	CONTINGENCY (15-35%) ($)	TOTAL DOLLARS ($)
KEH	definitive design	325,176	0	22,372	52,132	399,680
	field engr./inspect.	122,700	0	15,841	20,781	159,322
	procurement	60,283	0	4,147	12,886	77,317
	24-in. tie-in	33,488	0	4,323	11,958	49,769
	collection sump 1	601,722	0	77,682	168,589	847,993
	6-in. aboveground effluent	149,008	0	19,237	42,061	210,306
	Subtotal-KEH	**1,292,377**	**0**	**143,602**	**308,407**	**1,744,387**
D/C Contractor	design of treatment system	647,500	99,175	103,116	212,448	1,062,239
	engr./inspect.	323,700	42,081	50,514	104,074	520,369
	site work	507,706	66,649	79,318	163,418	817,091
	diversion basin 1 & 2	799,238	103,901	124,724	256,966	1,284,828
	sump 2	148,942	19,363	23,243	47,887	239,435
	sump 3	143,628	18,672	22,414	46,178	230,891
	valve pits	213,922	27,810	33,383	68,779	343,894
	underground piping	49,721	6,464	7,759	15,986	79,929
	process treatment equipment	3,596,143	467,499	561,189	939,096	5,563,927
	treatment facility building	995,473	129,412	155,346	321,104	1,601,334
	discharge line	20,948	2,723	3,269	6,735	33,676
	Subtotal-D/C Contractor	**7,446,921**	**983,747**	**1,164,275**	**2,182,671**	**11,777,614**
WHC	operating contractor	79,251	0	9,875	22,281	111,407
	project management	878,000	0	109,399	197,480	1,184,879
	Subtotal - WHC	**957,251**	**0**	**119,274**	**219,761**	**1,296,286**
	Project Total	9,696,549	983,747	1,427,151	2,710,838	14,818,286

Cost estimates for each piece of equipment were prepared by KEH by summing costs in the following manner:

(1) equipment and labor costs were estimated;
(2) overhead and profit/bond and insurance (OH&P/B&I) costs were estimated;
(3) indirect costs, primarily administrative costs, were calculated as a percent (about 13 percent) of the sum of (1) and (2);
(4) escalation costs were developed, ranging from 7 to 14 percent of the sum of (1), (2), and (3); and
(5) contingency costs, varying from 15 to 35 percent of the sum of all the previous costs.

The total cost of each piece of equipment is then the sum of these five costs.

3. EVALUATION OF DOE'S PROJECT COSTS

Although it appears that either treatment system would effectively treat the 300-Area process wastes, the $39M system was rejected by DOE and therefore the following discussion is limited to the $15M design.

The $15M process system proposed by KEH uses proven technologies that should adequately remove organics, inorganics, and radionuclides from the 300-Area process water. Two areas of concern, however, were noted during the review of the current process design. First, the use of granular activated carbon has been avoided at another DOE site (881 Hillside Area, Rocky Flats, Colorado) for removing organics from radionuclide-contaminated water because uranium may irreversibly adsorb to the activated carbon. Therefore, treatability studies should be performed using activated carbon to determine whether uranium will be a problem for the 300-Area process water. Depending on the uranium concentration in the process water, adsorption of uranium to the carbon could pose disposal problems.

The second potential problem with the current process system regards the filter flushing operations. Page 16 of the $15M CDR states that "...periodic backwash water from the multimedia filters can be routed directly to the river discharge line since none of the toxic materials will be retained on the filter media." Since the backwash may contain toxic materials, including insoluble metals and radionuclides, the backwash should be tested prior to discharge.

The reviewers evaluated the accuracy of the materials and labor costs for process equipment, buildings, and other structures by comparing KEH's estimates to estimates from vendors, costs for similar work performed by PRC Environmental Management, Inc. (a private environmental consulting firm), and information from the Means' Construction Cost Data catalog. Cost estimates for water treatment process equipment appeared to be accurate with relatively small discrepancies. For example, KEH's estimated cost for the reverse osmosis (RO) unit is $350,000, while the cost obtained by the reviewers from a vendor of a similar RO unit was $300,000 (Matkovits, 1990). KEH's estimate for the dual media filter was $40,000 higher than an estimate obtained by the reviewers, (Matkovits, 1990). However, other process equipment, such as the ion exchange unit, were priced lower in KEH's estimates ($150,000) than the quote of $200,000 obtained by the reviewers (Dean, 1990).

Of all equipment and structures examined, sump 1, the facility building, and the 6-inch aboveground effluent line appear to be the only items that exhibit high prices. The cost of sump 1 is estimated at $600,000 for materials and labor. A large portion of this cost is for PVC electrical wiring conduits encased in concrete ducts ($100,000). WHC has indicated that the revised CDR omits the use of concrete encasement, and will use aboveground electrical wiring instead. WHC has also indicated that sump 1 was oversized in the original CDR and that the cost of this item will be significantly reduced in the revised CDR. A $220,000 building for housing sump 1 is also included in the $600,000 estimate. This building is being provided to house control equipment and to keep pipes from freezing. Heat tracing and insulating pipes and pumps should be a more economical alternative to housing the sump, and should be considered in future designs.

The facility building cost is estimated at about $580,000. This estimate does not include escalation and contingency costs. This corresponds to a cost of $90 per square foot. Typical building costs in the private-sector for similar structures range from $50 to $60 per square foot. WHC has indicated that approximately 37 percent of the total building cost is attributed to electrical hook-up and equipment costs. WHC stated that the high electrical costs are due to the large power and wiring requirements for the process equipment, motors, and constrol systems (Vanselow, 1990). Taking this into consideration, building costs for the treatment plant still appear to be high, but within reason.

The 6-inch diameter, 1560-foot-long aboveground effluent line is priced at $149,000. This corresponds to a pipe cost of $95 per foot installed. Nearly half of this cost is attributed to heat tracing and insulation. The reviewers suggested to WHC that this pipe be placed underground to avoid these costs. In response, WHC indicated that soils are likely to be contaminated in this area and excavation is being avoided to preclude costs incurred for disposing of this soil.

OH&P/B&I calculated for each work and equipment item in KEH's estimate averaged 26 percent of the material and labor costs. Typical engineering procedures use a profit of 10 percent and an overhead of 15 percent of the material and labor cost for work and equipment items. Thus, a 26 percent OH&P/B&I cost is an acceptable percentage for the majority of the work and equipment involved in this project. The only items exhibiting excessive OH&P/B&I costs are packaged water treatment process equipment. The term "packaged" corresponds to preassembled equipment purchased from a vendor, and often installed by the vendor. Costs for these items can be found on page 46 of KEH's cost breakdown in Appendix E. Labor costs are low, in comparison with the material costs, for packaged equipment because the equipment is preassembled and installed by the vendor. Because the labor costs are low, overhead costs are low. Therefore, OH&P/B&I costs should be less than 26 percent of the material and labor costs for this equipment. According to WHC, at least one change has been made in OH&P/B&I costs for packaged equipment in the revised CDR; the OH&P/B&I for the evaporator/crystallizer ($1,500,000) has been reduced from 26 percent of its cost ($400,000) to 10 percent ($150,000) (Carrigan, 1990).

The remaining costs -- escalation, contingency, and other indirect costs -- appear to be of a reasonable magnitude. KEH calculated escalation costs at approximately 6.9 percent per year, an acceptable estimate for construction in the Tri-City area. An average contingency of 23 percent was estimated for this project. This estimate is also reasonable considering the level of cost accuracy at this level of design (typical preliminary construction cost estimates have a level of accuracy of as much as ±30 percent). Other indirect costs, which are dominated by administration costs, average 12 percent of the estimate subtotal (materials, labor, and OH&P/B&I). This estimate is reasonable as administration costs typically average 10 percent for similar projects.

The D/C Contractor's engineering fee, including design and inspection, is 13.4 percent of the capital investment for that work done by the D/C Contractor. KEH's total engineering fee ($559,000), which includes design and inspection fees, is 50 percent of the capital investment for that work done by KEH. KEH's engineering design fee ($400,000) includes costs for designing the tie-in to the existing 300-Area effluent pipe, sump 1, and new piping to the water treatment plant. It also includes costs for preparing the preliminary specifications to be used by the D/C Contractor in preparing the treatment plant designs. KEH's design fee is 36 percent of the total capital investment for that work done by KEH while typical design fees vary between 10 and 15 percent of the total capital investment. KEH's engineering inspection fee ($159,000) includes costs for inspecting construction work done by both KEH and the D/C Contractor.

Although every process design is unique, engineering fees typically vary between 10 and 30 percent of the total capital investment (Peters and Timmerhaus, 1980). The D/C Contractor's engineering fee is well within this range. KEH's engineering fees, on the other hand, are between $225,000 and $450,000 higher than expected. The majority of this fee is attributed to design preparation. A total of 5,072 man-hours have been proposed to prepare the designs (50 man-hours are allotted for specifications preparation). This level of effort seems extreme considering that the designs are for relatively simple process operations.

Total management costs for this project, including WHC's project management and KEH's administration costs, are 15 percent of the total capital investment. Typical management and administrative costs range from 5 to 10 percent of the total capital investment cost. The 15 percent may be incurred due to the proposed multitiered structure (WHC, KEH, and D/C Contractor) for completing this activity. The information provided to the reviewers does not allow for a definitive evaluation of management costs.

4. SUMMARY AND CONCLUSIONS

Upon reviewing the $39M and $15M designs proposed for treating the 300-Area process water, the reviewers discovered that both designs will treat only 300 gpm. The $39M water treatment plant was designed to accept 1200 gpm of process water from the 300-Area. However, only 300 gpm was to undergo treatment in the plant, while the remaining 900 gpm would be discharged to the Columbia River without treatment, assuming that the required permits were obtained. The additional $24 million associated with the $39M design is primarily attributed to the construction of five 2.8 million-gallon retention basins used to retain the untreated process flow until it could be sampled, analyzed, and shown to meet discharge limits prior to release into the Columbia River.

Because both plant designs only treat 300 gpm of process water, and the minimum expected flow to the plant from the 300-Area is 200 to 300 gpm, this plant would not likely have adequate capacity to treat contaminated groundwater produced in future remedial actions, while maintaining adequate contingency capacity for peak flows of process water. Oversizing the treatment plant to allow for treating contaminated groundwater may be economically advantageous in the long-term, and therefore should be considered prior to proceeding further in the design process.

The reviewers recommend that DOE prepare detailed cost estimates for treatment options, comparing the $15M design to the option of tying into the City of Richland treatment plant. The initial administrative cost of obtaining permits should be considered, as should the cost of retaining the permits over the long-term. A realistic evaluation should also be made as to whether an NPDES or state 216 discharge permit can be obtained in a timely manner, to coincide with milestone M-17-09, which requires completion of the 300-Area treated effluent system by June 1995. In addition, long-term operation and maintenance costs and closure costs should be considered for the $15M design. The feasibility of adding contaminated groundwater to the process effluent should be considered in both the $15M design and the City of Richland treatment plant options.

KEH prepared very detailed cost estimates for the 300-Area Process Water Treatment Plant and, for the most part, the estimates are reasonable. The total cost of the treatment plant, however, is somewhat higher than expected for a plant with a 300 gpm treatment capacity.

Areas where estimates do appear high include costs for buildings, sump 1, OH&P/B&I on packaged process equipment, and KEH's engineering fees. It is difficult to accurately determine the extent to which these costs are in excess without examining detailed construction drawings and associated design plans. Construction cost estimates have been prepared for each of these items in Table D-4 to provide a means of cost comparison. The PRC estimates are based on average costs experienced in the private-sector for construction activities, with no attempt to account for factors unique to Hanford. As can be seen in Table D-4, KEH's estimates are $1.5 million higher than the estimates for these four items. To lower costs, KEH should eliminate unnecessary expenditures for constructing buildings and sump 1 and lower the OH&P/B&I costs on packaged process equipment. In addition, KEH should explain how its engineering design fees were estimated.

TABLE D-4
CONSTRUCTION COST COMPARISON

Item	KEH Estimate	PRC Estimate	Difference
Treatment Facility Building[1]	$825,000	$438,000[2]	$387,000
Sump 1[1]	$848,000	$242,000[3]	$606,000
OH&P/B&I for Packaged Process Equipment	$598,000	$345,000[4]	$253,000
Engineering Design Fee[1]	$400,000	$166,000[5]	$234,000
Total			$1,480,000

(1) Estimates are total cost estimates, including materials, labor, escalation, contingency, and other indirect costs.

(2) Estimated using $60/ft^2 building cost (average from private-sector experience).

(3) Estimated using $500 per gpm per sump flow capacity (Smith, 1990).

(4) Packaged process equipment included filters, GAC beds, RO unit, ion exchange unit, and evaporator/crystalizer. A 15 percent OH&P/B&I was estimated for this equipment.

(5) Estimated using 15 percent design fee (average from private-sector experience).

E. LABORATORY ANALYSIS COSTS

1. BACKGROUND

The reviewers have studied and evaluated analytical laboratory costs associated with conducting remedial activities at Hanford. Westinghouse Hanford Company (WHC) personnel directly involved in laboratory services were interviewed, and pertinent documents were reviewed. Private commercial laboratories were contacted in order to obtain information on analytical costs.

WHC and Pacific Northwest Laboratories (PNL) analytical laboratories at Hanford support facility effluent monitoring and hazardous waste management programs, provide waste characterization, implement various DOE Orders, and support regulatory permitting activities. With these activities, new sampling and analysis protocols have been required of the onsite laboratories. The new protocols include sample chain-of-custody documentation, more frequent instrument calibration, more extensive processing of additional standards and blanks, sample archiving, enhanced personnel training, detailed quality assurance plans, and an increased level of overall documentation (Joyce, 1989).

As a result of the increased analytical responsibilities, a laboratory upgrade program was developed to effectively provide the required laboratory support to the various Hanford environmental programs (Joyce, 1989). The upgrade strategy is to (1) maximize the capabilities and capacities of the WHC 222-S and PNL 325 laboratories, (2) construct the Waste Sampling and Characterization Facility (WSCF) to handle nonradioactive, low-level radioactive, and dangerous/hazardous waste samples, (3) use the PNL laboratories for analytical methods development, and (4) use the Hanford Environmental Health Foundation (HEHF) as a referee laboratory. The WHC Office of Sample Management (OSM) has been established to coordinate programmatic needs with laboratory capabilities. OSM will make sample projections, monitor laboratory performance, and coordinate the use of onsite and offsite laboratories (Joyce, 1989).

2. DESCRIPTION OF DOE'S ANALYTICAL COSTS

The estimated analytical costs provided by WHC are based on historical costs and expected trends and on sample projections that were revised to address remedial activities (Stroup, 1990a). Samples obtained during remedial activities may contain hazardous chemical constituents as well as radionuclides. Since sample radioactivity determines laboratory handling (Stroup, 1990b), WHC has categorized sample materials according to dose levels, as follows:

- Nonradioactive,
- Less than 1 mR/hr,
- Greater than 1 mR/hr but less than 100 mR/hr, and
- Greater than or equal to 100 mR/hr.

Table E-1 shows estimated costs for various types of sample analyses at different laboratories (Stroup, 1990b). This information was provided by WHC in response to the reviewers' request for cost information.

Projected costs for in-house analytical services are based on "unbatched" sample unit costs. In general, "per sample" analytical costs as shown in budget projections (Stroup, 1990b) represent "unbatched" sample costs (i.e., one sample per shipment). These are applicable to both primary and split laboratories. These estimated costs are based on the assumption that the entire cost of laboratory quality control (QC) sample analyses is passed on to the customer through the "per sample cost" (Stroup, 1990b). These unit costs were based on bid prices received by WHC from commercial laboratories (WHC, 1989).

At this time, the PNL 325 Laboratory analytical costs are about $1,000 to $2,000 higher per sample than for the WHC 222-S Laboratory, as shown on Tables E-1 and E-3. This comparison is for similar matrices and the same analytical procedures for typical cleanup program samples. WHC is currently trying to resolve these differences (Stroup, 1990b).

The following provides details about the sample analytical costs for the four categories, according to the radioactivity levels, listed above.

a. Nonradioactive Samples
The estimated costs for analyzing a nonradioactive sample for target compound list (TCL) and target analyte list (TAL) parameters in accordance with the Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP) statements of work are provided in Table E-2. The costs also include WHC costs for radioactivity screening, packaging, offsite shipment, and final sample disposal (Stroup, 1990b).

TABLE E-1
WHC ESTIMATED UNIT SAMPLE COSTS[a]

SAMPLE TYPE	FACILITY	COST ($)
Water, Nonradioactive	PNL	1,300[b]
Soil, Nonradioactive	Offsite	3,500
	WSCF	3,500
Soil, <1 mR/hr	Offsite[c]	4,700
	WHC 222-S	6,000
	PNL 325	7,000
	WSCF	4,000
Soil, 1 to 100 mR/hr	WHC 222-S	7,000
	PNL 325	8,000
	WHC 222-S(with upgrades)	5,500
	PNL 325(with upgrades)	6,500
Soil, >100 mR/hr	WHC 222-S	15,000
	PNL 325	17,000
	WHC 222-S(with upgrades)	10,000
	PNL 325(with upgrades)	12,000
Single-Shell Tank (SST) Core [d]	WHC 222-S	290,000
	PNL 325	340,000

(a) Analysis include CLP TCL and TAL for all samples. Analyses of radioactive samples also include total alpha, total beta, gamma energy analysis (Cs-137, Co-60, Ru-106), Tc-99, Sr-90, and Pu/U isotopes for all but SST samples.
(b) Cost for analyses only, total cost not provided.
(c) Does not include Pu/U isotopes.
(d) Samples analyzed for wide range of radionuclides, organics, and inorganics (see Appendix F).
Source: Stroup, 1990b and 1990c

TABLE E-2
ESTIMATED ANALYTICAL COSTS FOR NONRADIOACTIVE SAMPLES[a]

SAMPLE TYPE	FACTOR	COST	TOTAL COST
Water Analysis-Onsite	PNL 325	$1,300	Not Provided
Soil Analysis-Offsite			$3,300-$3,800
	WHC Screening	$ 200	
	WHC Shipping	$ 200	
	Offsite Laboratory	$2,800-$3,300	
	WHC Sample Disposal	$ 100	
Soil Analysis-Onsite			$3,000-$4,000
	WSCF Laboratory	$2,900-$3,900	
	WHC Sample Disposal	$ 100	

(a) Analyses include CLP TCL and TAL parameters.

Source: Stroup, 1990b and 1990c

TABLE E-3
ESTIMATED ANALYTICAL COSTS FOR SOIL SAMPLES CONTAINING RADIOACTIVITY[a]

ACTIVITY LEVEL	FACTOR	COST	TOTAL COST
<1 mR/hr	Offsite		\$ 4,200-\$5,200
	WHC Screening	\$ 200	
	WHC Shipping	\$ 300	
	Laboratory	\$3,500-\$4,500	
	WHC Sample Disposal	\$ 200	
	Onsite		\$ 6,000-\$7,000
	WHC 222-S	\$5,800	
	PNL 325	\$6,800	
	WHC Sample Disposal	\$ 200	
	Onsite		\$ 3,500-\$4,500
	WSCF Laboratory	\$3,300-\$4,300	
	WHC Sample Disposal	\$ 200	
1 to 100 mR/hr	Onsite		
	WHC 222-S	b	\$ 7,000
	PNL 325	b	\$ 8,000
	WHC 222-S(with upgrades)	b	\$ 5,500
	PNL 325(with upgrades)	b	\$ 6,500
>100 mR/hr	Onsite		
	WHC 222-S	b	\$15,000
	PNL 325	b	\$17,000
	WHC 222-S(with upgrades)	b	\$10,000
	PNL 325(with upgrades)	b	\$12,000

(a) Analyses include CLP TCL and TAL parameters, total alpha, total beta, gamma energy analysis (Cs-137, Co-60, Ru-106), Tc-99, Sr-90, and Pu/U isotopes.
(b) Cost factors not provided; sample disposal is included.

Source: Stroup, 1990b

Sample screening is used to classify samples as nonradioactive or radioactive prior to transport to offsite laboratories. Based on the assumption that any given sample may contain radioactivity, WHC has developed a sample screening protocol to classify samples by activity using gross alpha, beta, and gamma scans (Stroup, 1990c). According to WHC, this protocol, which will involve mobile laboratory sampling and the WHC 222-S Laboratory, is necessary to prepare for transportation of samples and to determine which facility (offsite or onsite) can safely process and analyze them (Joyce, 1989 and Stroup, 1990d).

The following values are the limits below which WHC (Stroup, 1990c) considers a sample nonradioactive and suitable for analysis at an offsite commercial laboratory:

- Total alpha -- <60 pCi/g,
- Total beta -- <200 pCi/g, and
- Gamma energy analysis -- <200 pCi/g.

At present, samples that only contain hazardous chemical constituents are analyzed offsite at commercial facilities, in accordance with EPA's CLP statements of work for organics and inorganics. The WHC Professional/Maintenance Services Procurement Office is in the process of establishing contracts with commercial laboratories for these services (Wilson, 1990). WHC believes that it will continue to be more cost effective to have these samples analyzed by commercial laboratories until such time as the WSCF is operational (Stroup, 1990d). At this time, the PNL 325 Laboratory has the capability to analyze samples in accordance with CLP requirements. WHC anticipates that the WHC 222-S Laboratory will also have that capability in early 1991 (Stroup, 1990b). Neither of these laboratories were analyzing remedial investigation samples at the time of this review.

b. Radioactive Samples

Table E-3 provides the costs of analyzing samples that exhibit radioactivity. WHC procedures mandate that radioactive samples be analyzed in a protective environment, depending on their activity level, as follows:

- Less than 1 mR/hr -- offsite commercial laboratory, or onsite in hood with high efficiency particulate air (HEPA) filtration,
- Greater than 1 mR/hr but less than 100 mR/hr -- onsite in shielded hood, and

- Greater than or equal to 100 mR/hr -- onsite in hot cell.

The projected costs range from $3,500 to $12,000 per sample, depending on the radioactivity level and the laboratory chosen. According to WHC, once the WSCF is operational and the laboratory upgrades are complete, analytical costs for typically requested analyses, as shown on the list below, are expected to decrease by 25 to 40 percent of the current combined onsite and offsite costs.

- Inorganics -- CLP TAL
- Organics -- CLP TCL
- Total alpha
- Total beta
- Uranium (U) isotopes
- Plutonium (Pu) isotopes
- Strontium-90 (Sr-90)
- Technicium-99 (Tc-99)
- Gamma energy analysis [Cesium-137 (Cs-137), Cobalt-60 (Co-60), and Ruthenium-106 (Ru-106)]

If radioactive samples (<100 mR/hr) are to be analyzed offsite, additional preliminary analyses will be performed onsite prior to shipment in order to ensure (1) that the safety of offsite laboratory personnel is not compromised and (2) that the laboratory has the licenses and capabilities needed to perform the required analyses (Stroup, 1990d). At the time of this cost evaluation project, WHC was attempting to establish an agreement with Oak Ridge National Laboratory to analyze radioactive samples (Wilson, 1990).

WHC believes that costs for shipping low-level radioactive samples offsite will result in higher costs than identical services onsite (Stroup, 1990d), although no documentation was provided to support this assumption. According to WHC, low-level radiochemical services at offsite laboratories may be insufficient to meet analytical program needs (Stroup, 1990d). The following justification was provided by WHC (Stroup, 1990b) to address the issue of high costs associated with analyzing radioactive samples and to provide the rationale for performing such analyses onsite:

- Most commercial laboratories do not use mass spectrometry or ICP-MS analytical methods required to obtain acceptable detection limits for plutonium and uranium isotopic analyses.

- Numerous samples will require short analytical turn-around times that cannot be provided by offsite laboratories.

- Radioactivity standards for samples producing 1 to 100 mR/hr cost about five times more than the standards for samples producing less than 1 mR/hr because of matrix interferences.

- Shipping costs for samples with more than 1 mR/hr of activity can be over $1,000 per shipment.

- High costs are associated with developing and obtaining an adequate supply of approved shipping containers. It can cost up to $500,000 to obtain approval of a shipping container.

- High-level radiochemical analyses cannot be performed at offsite commercial laboratories, because most laboratories cannot accept samples with activities greater than 1 mR/hr.

<u>c. Single-Shell Tank Samples</u>

WHC has provided estimated costs for analyzing single-shell tank (SST) core samples, as shown in Table E-4. Each core sample is expected to cost $290,000 if analyzed at the WHC 222-S Laboratory or $340,000 if analyzed at the PNL 325 Laboratory. According to WHC, the primary reasons for the high costs are extensive sample preparation steps that are labor intensive (i.e., sample splitting, separation, extraction) and numerous matrix interference problems (Stroup, 1990e). Figures showing the analyses now being performed on these samples are provided in Appendix F (Stroup, 1990f).

<u>d. Description of Onsite Laboratory Costs</u>

Onsite laboratory cost estimates include an analytical operations cost and an assessment fee or "tax" (Stroup, 1990a and 1990d). The analytical operations cost includes specific analyses, preparation of standards, and chemist support for equipment monitoring, report generation, computer support, and OSM assistance (Stroup, 1990g). The assessment fee is for laboratory operation, maintenance, and repair (Stroup, 1990g).

The assessment fee includes preventive and predictive maintenance, housekeeping, radiation protection technician support, facility engineering, quality engineering, planning and material coordinator support,

TABLE E-4
ESTIMATED ANALYTICAL COSTS FOR SINGLE-SHELL TANK CORE SAMPLES

ONSITE ANALYTICAL LABORATORY FACTORS	COST	TOTAL
WHC 222-S		$290,000
Hot Cell	$ 25,000	
Physical Characteristics	$ 10,000	
Organics	$ 30,000[a]	
Inorganics	$ 20,000	
Radionuclides	$ 50,000	
Receipt	$ 1,000	
Data Package	$ 7,000	
OSM Validation	$ 1,000	
Quality Assurance	$ 1,000	
Laboratory Assessment	$145,000	
PNL-325		$340,000
Hot Cell	$ 31,000	
Physical Characteristics	$ 12,000	
Organics	$ 30,000	
Inorganics	$ 24,000	
Radionuclides	$ 61,000	
Receipt	$ 1,000	
Data Package	$ 9,000	
OSM Validation	$ 1,000	
Quality Assurance	$ 1,000	
Laboratory Assessment	$170,000	

(a) PNL 325 Laboratory.
Source: Stroup, 1990d

stockroom operation, all service assessments (steam, laundry, electricity, waste disposal, etc.), and all other costs associated with repair and maintenance of the facility complex. With the exception of required room air sample analyses, no analyses are performed under this work scope (Stroup, 1990g).

The laboratory assessment is part of the accounting practice at Hanford used to cover what are often called "overhead costs." These costs vary from laboratory to laboratory, depending on various factors, such as the kind of security involved and the types of analyses to be performed (Stroup, 1990g). For example, a laboratory that performs radiological analyses is considered by WHC to have higher costs than one that only does cold (nonradioactive) analyses (Stroup, 1990g). Similarly, a laboratory that is located in a secured area will cost more to operate than one in an unsecured area (Stroup, 1990g).

The assessment is applied to analytical operations costs at a rate of 100 percent of operations cost (Stroup, 1990a). The 100 percent value is based on historical data (Joyce, 1989).

Costs associated with the OSM are shown as part of the Laboratory Upgrade Program through fiscal year 1990. Starting in fiscal year 1991, OSM costs will be included in analytical operations costs (Stroup, 1990h).

3. EVALUATION OF DOE'S ANALYTICAL COSTS

The reviewers' evaluation of WHC's analytical cost projections is limited in scope, because of the lack of detailed cost factors available from WHC. Specifically, two items should be clarified.

First, a cost analysis of the per-sample analytical cost projections, both prior to and after laboratory upgrades (as shown previously in Tables E-2 and E-3) must be provided in order to evaluate these costs. The cost analysis should itemize cost factors such as sample volume capacity (number of samples per hour or day), labor requirements and wage rates, material costs (e.g., reagents, standards, etc.) and operating expenses. The cost analysis should demonstrate that the $39,120,000 capital expenditure for the laboratory upgrades will result in the reduction of analytical costs projected by WHC (Stroup, 1990a).

Second, the basis for the laboratory operating budgets projected for 1990 through 2020 (Stroup, 1990a) should be provided. The reviewers' comparison of the total annual operating budget to estimated analytical costs shows discrepancies that should be explained. For example, the total laboratory operating budget for the three laboratories -- WSCF, WHC 222-S, and PNL 325 -- for fiscal year 1996 is estimated to be $16,400,000 (Stroup, 1990a). In contrast, the summation of the per-sample analytical costs, multiplied by the projected number of samples in each radioactivity level, total is $26,000,000 (Stroup, 1990a). There are three possible explanations for this difference (1) an unknown factor such as the assessment fee makes up the difference, in which case the operating budget does not reflect the true cost, and the assessment fee amounts to only 58 percent, instead of 100 percent; (2) the laboratory budget is insufficient for the projected number of samples; or (3) the per-sample analytical cost is too high. In any case, the differences among these figures should be reconciled.

a. Private-Sector Costs

This section presents a comparison of private-sector costs for laboratory analyses of nonradioactive and low-level (less than 1 mR/hr) radioactive samples. The cost comparison is limited to these two categories, because commercial laboratories are not equipped to handle mixed-waste samples with radioactivity levels greater than 1 mR/hr.

The reviewers tried to obtain information about overhead rates from several commercial laboratories in order to compare the assessment fee with the private-sector overhead rate. However, this information could not be obtained, because commercial laboratories provide fixed unit price costs to customers, and overhead costs are considered confidential. Therefore, the appropriateness of WHC's 100 percent assessment fee could not be established.

The analytical costs obtained from commercial laboratories for nonradioactive samples to be analyzed for CLP TAL and TCL parameters ranged from $1,150 to $1,560 for water samples, and from $1,250 to $1,670 for soil samples. The analytical costs for low-level radioactive samples are presented in Tables E-5 and E-6. These costs were compiled using the parameter list that WHC provided as "typical radioactive analyses requested on CLP sample." Average analytical costs are $2,510 for water samples and $2,696 for soil samples.

TABLE E-5
ESTIMATED PRIVATE-SECTOR ANALYTICAL COSTS FOR WATER SAMPLES, <1 mR/hr

PARAMETER LIST	CORE LABORATORIES	IT ANALYTICAL SERVICES	THERMO-ANALYTICAL[a]
CLP TCL	$1,400	$1,281	$2,000[b]
CLP TAL	$ 450	$ 500	--
Total Alpha and Beta	$ 45	$ 60	$ 50
Gamma Spectral Analysis[c]	$ 130	$ 70	$ 116
Isotopic Plutonium	$ 110	$ 130	$ 133
Isotopic Uranium	$ 80	$ 130	$ 133
Sr-90	$ 70	$ 100	$ 102
Tc-99	$ 90	$ 150	$ 200
Total	$2,375	$2,421	$2,734

(a) Thermoanalytical can accept radiochemistry samples exhibiting up to 10 mR/hr, but TCL and TAL samples must be <1 mR/hr. CLP sample prices include a $100 radioactivity screening charge.
(b) Includes CLP TAL.
(c) Includes Cs-137, Co-60, and Ru-106.

TABLE E-6
ESTIMATED PRIVATE-SECTOR ANALYTICAL COSTS FOR SOIL SAMPLES, <1 mR/hr

PARAMETER LIST	CORE LABORATORIES	IT ANALYTICAL SERVICES	THERMO-ANALYTICAL[a]
CLP TCL	$1,400	$1,456	$2,120[b]
CLP TAL	$ 450	$ 650	--
Total Alpha and Beta	$ 45	$ 45	$ 70
Gamma Spectral Analysis[c]	$ 120	$ 70	$ 152
Isotopic Plutonium	$ 100	$ 145	$ 143
Isotopic Uranium	$ 80	$ 145	$ 143
Sr-90	$ 70	$ 100	$ 120
Tc-99	$ 80	$ 175	$ 210
Total	$2,345	$2,786	$2,958

(a) Thermoanalytical can accept radiochemistry samples exhibiting up to 10 mR/hr, but TCL and TAL samples must be < 1mR/hr. CLP sample prices include a $100 radioactivity screening charge.
(b) Includes CLP TAL.
(c) Includes Cs-137, Co-60, and Ru-106.

b. Cost Comparison

Table E-7 lists the commercial laboratory costs, together with WHC costs for nonradioactive and low-level radioactive (less than 1 mR/hr) samples.

Nonradioactive Samples WHC provided only one cost estimate for nonradioactive water samples ($1,300 for samples analyzed onsite at PNL). This cost was provided with no explanation and may not include the laboratory assessment fee. As it stands, this price compares very closely to the private-sector cost quotes obtained by the reviewers. In contrast, the nonradioactive soil sample costs provided by WHC are at least 2 times higher than those obtained by the reviewers from commercial laboratories. The costs of preparing, screening, and shipping samples were not included in the off-site cost estimates.

Radioactive Samples Since no cost information was provided by WHC for radioactive water samples, the reviewers were only able to compare the costs involving soil samples. The WHC offsite commercial laboratory cost is 1.5 times higher than quotes that the reviewers obtained from commercial laboratories. The costs of performing the same analyses onsite at WHC 222-S Laboratory or PNL 325 Laboratory are 2.3 times higher than quotes the reviewers obtained from commercial laboratories. The costs of preparing, screening, and shipping samples were not included in the off-site cost estimates.

4. SUMMARY AND CONCLUSIONS

Based on the reviewers' evaluation of the limited information provided by WHC about analytical costs, the per-sample cost for both nonradioactive and low-level radioactive soil samples is about 2 times higher than expected. The WHC cost for offsite laboratories may be higher if it includes some factor for quality control costs. The higher per-sample costs provided for the onsite laboratories may correspond to the 100 percent assessment fee applied to each sample. In any case, it does not appear that the WHC projected per-sample cost can reasonably be justified.

The current projections by WHC for upgrading and operating laboratories at Hanford for the next 30 years total $745,020,000, which includes $39,120,000 for upgrades and $705,900,000 for operation and maintenance (Stroup, 1990a). At present, there does not seem to be

TABLE E-7
COMPARISON OF PRIVATE-SECTOR AND HANFORD ANALYTICAL COSTS

SAMPLE TYPE	COMMERCIAL LABORATORY	WHC-OFFSITE	WHC-ONSITE
Nonradioactive			
Water	$1,150[a]	NR[b]	$1,300[c]
Soil	$1,250[a]	$3,050[d]	$3,400[d]
Low-Level Radioactive (<1 mR/hr)			
Water	$2,510[e]	NR[b]	NR[b]
Soil	$2,696[f]	$4,000[g]	$6,300[g]

(a) Based on price quote from Versar, Inc.
(b) Not reported.
(c) From Table E-1 (this report).
(d) Average cost from Table E-2 (this report).
(e) Average cost from Table E-5 (this report).
(f) Average cost from Table E-6 (this report).
(g) Average cost from Table E-3 (this report).

sufficient economic basis for making an informed decision involving expenditures of this magnitude.

Based on the reviewers' evaluation of the information provided by WHC, additional detailed cost analyses should be performed to address the following:

- The cost differences between samples analyzed at WHC 222-S Laboratory and those analyzed at PNL 325 Laboratory should be identified in order to ensure that the bases for the higher costs at the PNL facility can be evaluated and considered in future decisions regarding laboratory selection.

- A detailed cost analysis should be performed in order to demonstrate that the laboratory upgrade program will result in lower analytical costs and that the resulting difference in analytical costs justifies the capital expenditure.

- Given that 64 percent of the projected number of samples to be analyzed over the next six years (Stroup, 1990a) are in the <1 mR/hr category, additional investigations should be performed to evaluate the availability of and costs associated with using offsite commercial laboratories for nonradioactive and low-level radioactive samples.

- The costs of contracting to commercial laboratories should be compared to the laboratory upgrade program costs, once these costs have been better defined. As a basis of comparison, WHC should develop an alternative laboratory upgrade program that is geared toward onsite analysis of samples producing more than 1 mR/hr and offsite analysis of samples producing less than 1 mR/hr.

REFERENCES

Brown and Caldwell (B&C), 1990, Hanford Clean-up and Compliance Cost Analysis Statement of Work.

Brown, Randy, 1990, private consultant, personal communication with Willis Wilcoxon, PRC Environmental Management, Inc., Denver, CO, May 25, 1990.

Burgher, Brian, Culpepper, Mike, and Zieger, Werner, 1987, Remedial Action Costing Procedures Manual, EPA/600/8-87/049, October 1987.

Carrigan, Mark, Westinghouse Hanford Company, personal communication with Jeff Reichmuth, PRC Environmental Management, Inc., Denver, CO, May, 1990

Cooper, Hal, 1990, Westinghouse Hanford Company, personal communication with Deirdre O'Dwyer, PRC Environmental Management, Inc., Denver, CO, May 6, 1990.

CH2M Hill, 1986, Work Plan Guidance Handbook, REM IV Remedial Planing Activities at Selected Uncontrolled Hazardous Waste Sites - Zone II, July 30, 1986.

Dean, Lewis, 1990, Mile-Hi Culligan, personal communication with Jeff Reichmuth, PRC Environmental Management, Inc., Denver, CO, May 24, 1990.

Department of Energy (DOE), 1989a, Environmental Restoration and Waste Management Five-Year Plan, FY 92, ADS ID: 5125-EE-0, DOE/RL 89-17 Rev.1.

DOE, 1989b, Remedial Investigation/Feasibility Study Work Plan for the 200-BP-1 Operable Unit Operable Unit Hanford Site, Richland, Washington, November 1989, DOE/RL 88-32 Draft Revision 3.

DOE, 1990, Cost Estimating Handbook for Environmental Restoration, Final Draft, April 1990.

Unknown, 1985, Market Trends, Engineering News-Record (ENR), vol. 214, no. 23, pg 53.

Unknown, 1989, Market Trends, Engineering News-Record, vol 223, no. 9, pg 46.

Ferris, Oscar, Becker Drills, Inc., personal communication with Willis Wilcoxon, PRC Environmental Management, Inc., Denver, CO, May 25, 1990.

High, Carl, Boyle Brothers Drilling Co., 1990, personal communication with David West, PRC Environmental Management, Inc., Denver, CO, June 7, 1990.

Joyce, S.M., 1989, Hanford Environmental Laboratory Upgrade Program, SD-CP-PAP-001, March 1, 1989.

Matkovits, Monika, 1990, Osmonics, personal communication with Jeff Reichmuth, PRC Environmental Management, Inc., Denver, CO, May 29, 1990.

Means Cost Data Catalog (Means), 1989.

Patterson, Jim, 1990a, WHC, personal communication with Deirdre O'Dwyer, PRC Environmental Management, Inc., Denver, CO, July 12, 1990.

Patterson, Jim, 1990b, WHC, personal communication with Deirdre O'Dwyer, PRC Environmental Management, Inc., Denver, CO, June 7, 1990.

Peters and Timmerhaus, 1980, Plant Design and Economics for Chemical Engineers, McGraw-Hill, New York, 1980.

Ruiter, Terry, 1990, PRC, personal communication with Deirdre O'Dwyer, PRC Environmental Management, Inc., Denver, CO, August 23, 1990.

Smith, Terry, 1990, PRC, personal communication with Jeff Reichmuth, PRC Environmental Management, Inc., Denver, CO, June 5, 1990.

Stroup, Curtis, 1990a, WHC Internal Memo, "Sample Analyses/Budget Projections for Operable Units-Revision D," March 12, 1990.

Stroup, Curtis, 1990b, WHC, telefax communication with Donna Lacombe, PRC Environmental Management, Inc., Seattle, WA, May 14, 1990.

Stroup, Curtis, 1990c, WHC, personal communication with Richard Cheatham, C.C. Johnson & Malhotra (CCJM), Denver, CO, July 6, 1990.

Stroup, Curtis, 1990d, WHC, personal communication with Donna Lacombe, PRC Environmental Management, Inc., Seattle, WA, May 10, 1990.

Stroup, Curtis, 1990e, WHC, personal communication with Donna Lacombe, PRC Environmental Management, Inc., Seattle, WA, July 6, 1990.

Stroup, Curtis, 1990f, WHC Internal Memo, "Laboratory Sample Analysis Schedules," March 27, 1990.

Stroup, Curtis, 1990g, WHC, telefax communication with Richard Cheatham, CCJM, Denver, CO June 4, 1990 (1).

Stroup, Curtis, 1990h, WHC, telefax communication with Richard Cheatham, CCJM, Denver, CO June 4, 1990 (2).

Westinghouse Hanford Company (WHC), Assumptions for RI/FS Planning, undated.

WHC, 200-BP-1 Operable Unit Cost Estimate Printout, undated.

WHC, 1988, Summary Description of Draft Inactive Waste Disposal Site Study, April 1, 1988.

WHC, 1990, Cost Account Plan, 1EE323, Version 1990, May 8, 1990.

WHC, 1989, Professional/Maintenance Services Procurement, WHC Internal Memo, "Procurement Case File Memorandum-Modification Number 28," MLW-SVV-548357, May 25, 1989.

Wilson, Dave, 1990, WHC, personal communication with Donna Lacombe, PRC Environmental Management, Inc., Seattle, WA, July 10, 1990.

Wintczak, Tom, 1990a, WHC, personal communication with Deirdre O'Dwyer, PRC Environmental Management, Inc., Denver, CO, June 22, 1990.

Wintczak, Tom, 1990b, WHC, personal communication with Deirdre O'Dwyer, PRC Environmental Management, Inc., Denver, CO, May 29, 1990.

Wintczak, Tom, 1990c, WHC, personal communication with Deirdre O'Dwyer, PRC Environmental Management, Inc., Denver, CO, May 6, 1990.

Wintczak, Tom, 1990d, WHC, personal communication with Deirdre O'Dwyer, PRC Environmental Management, Inc., Denver, CO, May 16, 1990.

Wintczak, Tom, 1990e, WHC, personal communication with Deirdre O'Dwyer, PRC Environmental Management, Inc., Denver, CO, July 16, 1990.

Vanselow, Larry, 1990, WHC, personal communication with Jeff Reichmuth, PRC Environmental Management, Inc., Denver CO, September 25, 1990.

APPENDICES

APPENDIX A

COST ESTIMATING ASSUMPTIONS

Assumptions for RI/FS Planning

3.1 Scoping

Initiate - 4 months before initiation of work plan
Duration - 5 months
First month is background investigation
Next three months are field activities
Fifth month is scoping report
Basis for estimate:

Activity	Support	Hours	Cost in $K
Scoping			
Background Investigation	Engineering	320	18
Field Activities	Engineering	480	27
	RPT	160	13
	NPO's	320	14
	PNL/KEH	/	96
	Total		150
Scoping Report	Engineering	480	27

3.2 Work Plan

Initiate - 4 months after initiating scoping
Duration - 7 months preparation, 10 months review
Basis for estimate:

Activity	Support	Hours	Cost in $K
EMO WP Prep			
	Engineering	40	3
	QA	20	2
	Permitting	30	3
	EMO	640	48
	Total	/	56
EMO WP Review			
	Engineering	40	3
	QA	20	2
	EMO	3	36
	WHC	110	6.5
	Total	/	47.5

Work Plan
Basis for estimate (Continued)

Activity	Support	Hours	Cost in $K
Contract WP Prep			
	Engineering	160	9
	QA	40	3
	Geology	40	3
	Field Services	40	3
	Permitting	30	3
	Contractor	360	36
	Total	/	57
Contract WP Review			
	Engineering	80	4.5
	QA	20	2
	Contractor	2	24
	WHC	110	6.5
	Total	/	37

3.3 Site Characterization/Non-Intrusive Field Activities

Initiate - 10 months before initiation of RI-1 and RI-2 drilling
Duration - 10 months
Basis for estimate: Engineering judgement, estimate is $100K per month for all operable units except those associated with river sampling for which an additional $50K per month has been added.

3.4 Training

Initiate - 6 months before initiation of drilling for RI-1
Duration - 6 months
Basis for estimate:

Activity	Support	Hours	Cost in $K
Training/Ramp-up			
	RPT's	320	18
	NPO's	320	18
	Sampler's	320	18
	Engineers	320	18
	Total	/	72

3.5 Drilling Preparation/Mobilization

Initiate - 4 months before drilling for both RI-1 and RI-2
Duration - 4 months
Basis for estimate:

Activity	Support	Hours	Cost in $K
Drilling Prep			
	Health/Safety	80	4.5
	Procure/Control	40	2
	Prestart Docs	240	13.5
	Contractor	160	12
	EMO	320	24
	Total Contractor	/	32
	Total EMO	/	44

3.6 Drilling Support/Sub-Surface Characterization - RI-1

Initiate - 4 months after approval of work plan
Duration - Dependent on number of waste sites in operable unit
Basis for estimate:

Activity	Support	Hours	Cost in $K
Drilling Sampling			
	Team Leader	240	13.4
	QA	80	4.5
	Records	20	1.5
	Materials	/	210
	KEH	/	40
	Sampling	240	13.5
	RPT's	640	36
	NPO's	640	36
	Health/Safety	240	13.5
	Contractor	320	24
	EMO	480	36
	Total Contractor	/	192.5
	Total EMO	/	204.5

3.7 Drilling Support/Sub-Surface Characterization - RI-2

Initiate - At completion of RI-1 Report
Duration - 60% of RI-1 drilling
Basis for estimate:

Activity	Support	Hours	Cost In $K	
Drilling Sampling				
	Team Leader	240	13.4	
	QA	80	4.5	
	Records	20	1.5	
	Materials	/	9 ~~2~~10	(Correct materials cost = $10K/mo.) PB
	KEH	/	40	
	Sampling	240	13.5	
	RPT's	640	36	
	NPO's	640	36	
	Health/Safety	240	13.5	
	Contractor	320	24	
	EMO	480	36	
	Total Contractor	/	192.5	
	Total EMO	/	204.5	

3.8 Hazardous Waste Disposal and Decontamination

Initiate - At start of drilling
Duration - Same as drilling
Basis for estimate:

The number of waste sites per operable unit is a major factor in the cost and duration of the RI/FS activities. Therefore a matrix was developed to factor the number of waste sites in each operable unit into the following:

- Drilling duration
- Number of samples
- Cost of sample analysis
- Cost of decontamination
- Cost of hazardous waste disposal

The matrix contains the following assumptions:

- The number of sites, equals the number of cribs, ditches, ponds, trenches, burial grounds, etc., plus one of every three spills, drench drains and sanitary sewers
- Number of vadose zone holes equals three times the number of sites
- Number of groundwater wells equals number of sites
- Vadose zone hole depth is 50 ft for 100/300/200 Areas
- Groundwater well depths are 80 ft for 100/300 Areas and 300 ft for 200 Areas

Hazardous Waste Disposal and Decontamination
Basis for estimate (Continued)

- Equipment will be deconed between each hole or well and estimated to cost $18K per decon
- Hazardous waste disposal is estimated to cost $20 per ft for vadose zone holes and $5 per ft for groundwater wells
- Drilling rate for vadose zone holes is 10 ft per day per rig
- Drilling rate for groundwater wells is 20 ft per day per rig
- Drilling duration assumes two rigs per site working five days per week
- Number of samples from vadose zone holes equals 10 per hole
- Number of samples from groundwater wells equals 10 per hole
- Analysis cost for groundwater wells assumes $3K per sample
- Analysis cost for vadose zone holes assumes $6K per sample for 200 Area operable units and $4K per sample for 100/300 Area operable units

This is based on the following:

200 Area
5% hot cell @ $18K
45% rad bench @ $8K
50% CLP @ $3K
Average is $6K

100/300 Area
0% hot cell
20% rad bench @ $8K
80% CLP @ $3K
Average is $4K

3.9 Sample Analysis

Initiate - At start of drilling
Duration - Same as drilling
Basis for estimate:

The number of waste sites per operable unit is a major factor in the cost and duration of the RI/FS activities. Therefore a matrix was developed to factor the number of waste sites in each operable unit into the following:

- Drilling duration
- Number of samples
- Cost of sample analysis
- Cost of decontamination
- Cost of hazardous waste disposal

Sample Analysis
Basis for estimate (Continued)

The matrix contains the following assumptions:

- The number of sites, equals the number of cribs, ditches, ponds, trenches, burial grounds, etc., plus one of every three spills, drench drains and sanitary sewers
- Number of vadose zone holes equals three times the number of sites
- Number of groundwater wells equals number of sites
- Vadose zone hole depth is 50 ft for 100/300/200 Areas
- Groundwater well depths are 80 ft for 100/300 Areas and 300 ft for 200 Areas
- Equipment will be deconed between each hole or well and estimated to cost $18K per decon
- Hazardous waste disposal is estimated to cost $20 per ft for vadose zone holes and $5 per ft for groundwater wells
- Drilling rate for vadose zone holes is 10 ft per day per rig
- Drilling rate for groundwater wells is 20 ft per day per rig
- Drilling duration assumes two rigs per site working five days per week
- Number of samples from vadose zone holes equals 10 per hole
- Number of samples from groundwater wells equals 10 per hole
- Analysis cost for groundwater wells assumes $3K per sample
- Analysis cost for vadose zone holes assumes $6K per sample for 200 Area operable units and $4K per sample for 100/300 Area operable units

This is based on the following:

200 Area
5% hot cell @ $18K
45% rad bench @ $8K
50% CLP @ $3K
Average is $6K

100/300 Area
0% hot cell
20% rad bench @ $8K
80% CLP @ $3K
Average is $4K

3.10 Borehole Abandonment

Initiate - At start of vadose zone drilling
Duration - Same as vadose zone drilling
Basis for estimate: Engineering judgement based on experience, estimate is $40K per month.

3.11 Physical Analysis

Initiate - Lag 1 month behind vadose zone drilling
Duration - Same as vadose zone drilling
Basis for estimate: Engineering judgement, estimate is $50K per month.

3.12 Groundwater Monitoring

Initiate - At initiation of groundwater well drilling
Duration - Through ROD
Basis for estimate: Engineering judgement, 1 sample per well per quarter at $2K per sample.

3.13 RI Report Preparation

Initiate - At completion of drilling
Duration - Groundwater and source/groundwater operable unit - RI-1 -- 14 months, RI-2 -- 12 months, source operable unit -- 6 months
Basis for estimate:

Activity	Support	Hours	Cost in $K
EMO WP Prep			
	Engineering	40	3
	QA	20	2
	Permitting	30	3
	EMO	640	48
	Total	/	56
EMO WP Review			
	Engineering	40	3
	QA	20	2
	EMO	3	36
	WHC	110	6.5
	Total	/	47.5
Contract WP Prep			
	Engineering	160	9
	QA	40	3
	Geology	40	3
	Field Services	40	3
	Permitting	30	3
	Contractor	360	36
	Total	/	57

RI Report Preparation
Basis for estimate (Continued)

Activity	Support	Hours	Cost in $K
Contract WP Review			
	Engineering	80	4.5
	QA	20	2
	Contractor	2	24
	WHC	110	6.5
	Total	/	37

3.14 RI Report Review

Initiate - At completion of report preparation
Duration - 6 months
Basis for estimate:

Activity	Support	Hours	Cost in $K
EMO WP Prep			
	Engineering	40	3
	QA	20	2
	Permitting	30	3
	EMO	640	48
	Total	/	56
EMO WP Review			
	Engineering	40	3
	QA	20	2
	EMO	3	36
	WHC	110	6.5
	Total	/	47.5
Contract WP Prep			
	Engineering	160	9
	QA	40	3
	Geology	40	3
	Field Services	40	3
	Permitting	30	3
	Contractor	360	36
	Total	/	57

RI Report Review
Basis for estimate (Continued)

Activity	Support	Hours	Cost in $K
Contract WP Review			
	Engineering	80	4.5
	QA	20	2
	Contractor	2	24
	WHC	110	6.5
	Total	/	37

3.15 Work Plan Supplement

Initiate - 6 months before RI-2 drilling
Duration - 3 months preparation and 3 months review
Basis for estimate:

Activity	Support	Hours	Cost in $K
EMO WP Prep			
	Engineering	40	3
	QA	20	2
	Permitting	30	3
	EMO	640	48
	Total	/	56
EMO WP Review			
	Engineering	40	3
	QA	20	2
	EMO	3	36
	WHC	110	6.5
	Total	/	47.5
Contract WP Prep			
	Engineering	160	9
	QA	40	3
	Geology	40	3
	Field Services	40	3
	Permitting	30	3
	Contractor	360	36
	Total	/	57

Work Plan Supplement
Basis for estimate (Continued)

Activity	Support	Hours	Cost in $K
Contract WP Review			
	Engineering	80	4.5
	QA	20	2
	Contractor	2	24
	WHC	110	6.5
	Total	/	37

3.16 **Feasibility Report**

Initiate - Completion of FS 1 and 2 driven by initiation of RI-2 drilling
Completion of FS 3 is 6 months after 4 months of review on RI-2 report

Duration - FS 1 & 2 report preparation -- 10 months, review -- 6 months
FS 3 report preparation -- 14 months, review -- 6 months

Basis for estimate:

Activity	Support	Hours	Cost in $K
EMO WP Prep			
	Engineering	40	3
	QA	20	2
	Permitting	30	3
	EMO	640	48
	Total	/	56
EMO WP Review			
	Engineering	40	3
	QA	20	2
	EMO	3	36
	WHC	110	6.5
	Total	/	47.5
Contract WP Prep			
	Engineering	160	9
	QA	40	3
	Geology	40	3
	Field Services	40	3
	Permitting	30	3
	Contractor	360	36
	Total	/	57

Feasibility Report
Basis for estimate (Continued)

Activity	Support	Hours	Cost In $K
Contract WP Review			
	Engineering	80	4.5
	QA	20	2
	Contractor	2	24
	WHC	110	6.5
	Total	/	37

3.17 Performance Assessment

Initiate - PA-1 completion is driven by initiation of RI-2 drilling
PA-2 completion is 3 months before completion of FS-3 report
Duration - PA-1 is 24 months, PA-2 is 12 months
Basis for estimate: Engineering judgement, estimate is $15K per month for first phase and $20K per month for second phase.

3.18 Treatability

Initiate - Completion of treatability driven by completion of FS-3 report
Duration - 20 months or less depending on duration of Ri-2, does not start before RI-2 drilling
Basis for estimate: Engineering judgement, estimate is an average of $150K per month.

3.19 Environmental Assessment

Initiate - Completion of EA driven by completion of FS-3 Report
Duration - 18 months
Basis for estimate: Engineering judgement, estimate is $1,000K total.

3.20 Integrated Closure Plan

Initiate - Completion of closure plan driven by completion of FS-3 Report
Duration - 12 months
Basis for estimate: Engineering judgement, estimate is $30K per month.

3.21 Management

Initiate - At initiation of preliminary field activities
Duration - Initiation through ROD
Basis for estimate:

Activity	Support	Hours	Cost in $K
Management RI			
	Engineering	160	9
	Eng. Admin.	40	2
	QA	40	3
	Field Services	80	4.5
	Procedure Prep	640	36
	F.S. Admin.	40	2
	Contractor	160	12
	EMO	320	24
	Total Contractor	/	68.5
	Total EMO	/	80.5

3.22 Interim Remedial Actions

Westinghouse Hanford Company has overall management responsibility for RI/FS activities.

Contractors and EMO are subcontractors to WHC.

Hanford Site Contractors will be utilized for field and lab activities.

All operable units follow the RI/FS process.

RCRA TSD's currently designated as part of an operable unit will be addressed in an integrated manner with that operable unit.

Current operable unit concept continues.

Schedules are as shown with no delays due to Regulator reviews.

APPENDIX B

HAZARDOUS WASTE AND DECONTAMINATION AND SAMPLE ANALYSIS MATRIX

OU BGRD DATA

Operable Unit	RAD Cost	Monthly RAD Cost	RA Cost	Monthly RA Cost	Monthly Cost GWW	Monthly Cost VZH	Total GWW $	Total VZH $
300-FF-1	8000	533	160000	3556		512	0	3072
300-FF-5					524		2253	0
[redacted]								
200-BP-1	12650	843	253000	5622	172	672	710	2772
[redacted]								
100-HR-1	11500	767	230000	5111		512	0	1920
100-HR-3					524		2463	0
100-DR-1	19550	1303	391000	8689		512	0	3264
100-BC-1	25300	1687	506000	11244		512	0	4224
100-BC-5					524		1782	0
100-KR-1	5750	383	115000	2556		512	0	960
100-KR-4					524		1467	0
100-NR-1	9200	613	184000	4089	524	512	419	1536
100-FR-1	18400	1227	368000	8178	524	512	838	3072
100-NR-3	18400	1227	368000	8178	524	512	838	3072
200-UP-2	35650	2377	713000	15844	172	672	2000	7812

B1

# of Sites	# of VZH	# of GWW	VZH Ftge 100/300	VZH Ftge 200	GWW Ftge 100/300	GWW Ftge 200	VZH Decon $	GWW Decon $
16	48		2400				864	
43		43			3440		0	774
[redacted]								
11	33	11		1650		3300	594	198
[redacted]								
10	30		1500			0	540	0
47		47			3760		0	846
17	51		2550			0	918	0
22	66		3300			0	1188	0
34		34			2720		0	612
5	15		750			0	270	0
28		28			2240		0	504
8	24	8	1200		640		432	144
16	48	16	2400		1280		864	288
16	48	16	2400		1280		864	288
31	93	31		4650		9300	1674	558

B2

OU BGRD DATA

VZH Waste Disp.	GWW Waste Disp	VZH Weeks	VZH Months	VZH KEH $	GWW Weeks	GWW Months	GWW KEH $	VZH Samples
48	0	24	6	240	0	0	0	480
0	17	0	0	0	17	4	172	0
[redacted]								
33	17	17	4	165	17	4	165	330
[redacted]								
30	0	15	4	150	0	0	0	300
0	19	0	0	0	19	5	188	0
51	0	26	6	255	0	0	0	510
66	0	33	8	330	0	0	0	660
0	14	0	0	0	14	3	136	0
15	0	8	2	75	0	0	0	150
0	11	0	0	0	11	3	112	0
24	3	12	3	120	3	1	32	240
48	6	24	6	240	6	2	64	480
48	6	24	6	240	6	2	64	480
93	47	47	12	465	47	12	465	930

B3

OU BGRD DATA

VZH Lab Samples	VZH Analysis $	GWW Samples	GWW Lab Samples	GWW Analysis $	Total Drilling	Total Analysis$	Monthly Analysis $	Total Decon/Haz$
480	1920	0	0	0	6	1920	320	912
0	0	430	430	1290	4	1290	300	791
[redacted]								
330	1980	110	110	330	8	2310	280	842
[redacted]								
300	1200	0	0	0	4	1200	320	570
0	0	470	470	1410	5	1410	300	865
510	2040	0	0	0	6	2040	320	969
660	2640	0	0	0	8	2640	320	1254
0	0	340	340	1020	3	1020	300	626
150	600	0	0	0	2	600	320	285
0	0	280	280	840	3	840	300	515
240	960	80	80	240	4	1200	316	603
480	1920	160	160	480	8	2400	316	1206
480	1920	160	160	480	8	2400	316	1206
930	5580	310	310	930	23	6510	280	2372

B4

Monthly)econ/Haz$	Total $	Monthly Total $
152	3072	512
184	2253	524
[redacted]		
102	3482	422
[redacted]		
152	1920	512
184	2463	524
152	3264	512
152	4224	512
184	1782	524
152	960	512
184	1467	524
159	1955	515
159	3910	515
159	3910	515
102	9812	422

B5

APPENDIX C

200-BP-1 OPERABLE UNIT COST ESTIMATE

Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Dates	01/88	02/88	03/88	04/88	05/88	06/88	07/88	08/88	09/88	10/88	11/88	12/88	01/89	02/89	03/89	04/89	05/89	06/89	07/89	08/89	09/89	10/89	11/89
Scoping	18	150	150	150	27																		
Work Plan Prep					57	57	57	57	57	57	57												
Work Plan Review												37	37	37	37	37	37	37	37	37	37		
Field Activities																						100	100
Contractor Mgt																						68	68
Drilling Prep-Contr.																							
Training																							
Drill Sup - Contractor																							
Haz/Decon																							
Analysis																							
Borehole Abandonment																							
Physical Lab																							
Groundwater Monitor																							
RI Report Prep - Contr.																							
RI Report Rev - Contr.																							
PA																							
FS Report Prep - Contr.																							
FS Report Rev -Contr.																							
Treatibility																							
Environ Assess.																							
Total - Contr.	18	150	150	150	84	57	57	57	57	57	57	37	37	37	37	37	37	37	37	37	37	168	168
Total Quarterly			318			291			171			151			111			111			111		
Total Fiscal Year									780												484		

24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
12/89	01/90	02/90	03/90	04/90	05/90	06/90	07/90	08/90	09/90	10/90	11/90	12/90	01/91	02/91	03/91	04/91	05/91	06/91	07/91	08/91	09/91	10/91	11/91	12/91	01/92
100	100	100	100	100	- 100	100	100																		
68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
				32	32	32	32																		
		72	72	72	72	72	72																		
								193 102 280 40	193 102 280 40 50	193 102 280 40 50	193 102 280 40 50	193 102 280 50	193 102 280	193 102 280	193 102 280										
												7	7	7	7	7	7	7	7	7	7	7	7	7	7
																57	57	57	57	57	57	57	57	57	57
												15	15	15	15	15	15	15	15	15	15	15	15	15	15
																57	57	57	57	57	57	57	57	57	57
168	168	240	240	272	272	272	272	683	733	733	733	715	665	665	665	204	204	204	204	204	204	204	204	204	204
504			648			816			1688			2181			1995			612			612			612	
									3656												5400				
									3656 1990 3656												5400 1991 5724				

C2

- BP - 1

50 02/92	51 03/92	52 04/92	53 05/92	54 06/92	55 07/92	56 08/92	57 09/92	58 10/92	59 11/92	60 12/92	61 01/93	62 02/93
							57	57	57			
										37	37	37
					100	100	100	100	100	100	100	100
68	68	68	68	68	68	68	68	68	68	68	68	68
						32	32	32	32			
										193 102 280 40	193 102 280 40 50	193 102 280 40 50
7	7	7	7	7	7	7	7	7	7	7	7	7
57	57	57	57									
				37	37	37	37	37	37			
15	15	15	15	15	15	15	15	15	15			
57	57	57	57									
				37	37	37	37	37	37			
204	204	204	204	184	264	298	353	353	353	827	877	877
	612			572			913			1533		
							2709					
							2980 1992 3317					

63 03/93	64 04/93	65 05/93	66 06/93	67 07/93	68 08/93	69 09/93	70 10/93	71 11/93	72 12/93	73 01/94	74 02/94	75 03/94
100	100											
68	68	68	68	68	68	68	68	68	68	68	68	68
193 102 280 50	193 102 280											
15	15	15	15	15	15	15	15	15	15	15	15	15
		57	57	57	57	57	57	57	57	57	57	57
											20	20
												57
						150	150	200	200	200	200	200
								50	50	100	100	100
808	758	140	140	140	140	290	290	390	390	440	460	517
2562			1038			570			1070			1417
						5703						
						6273 1993 6982						

C3

76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101
04/94	05/94	06/94	07/94	08/94	09/94	10/94	11/94	12/94	01/95	02/95	03/95	04/95	05/95	06/95	07/95	08/95	09/95	10/95	11/95	12/95	01/96	02/96	03/96	04/96	05/96
																									495
																									570
																									481
																									2000
68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68	5372
																									256
																									432
																									2509
																									1326
																									3640
																									280
																									350
15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	759
57	57	57																							1596
			37	37	37	37	37	37																	444
20	20	20	20	20	20	20	20	20	20																600
57	57	57	57	57	57	57	57	57	57	57	57	57													1596
													37	37	37	37	37	37							444
200	150	150	150	150	150	150	150	150	150	50	50	50													3000
50	50	50	50	50	50	50	50	50	50	50	50	50													1050
467	417	417	397	397	397	397	397	397	360	240	240	240	120	120	120	120	120	120	83	83	83	83	83	83	27200
		1301			1191			1191			840			480			360			288			249	83	27200
					4979												2871							618	
					5477												3158							680	
					1894												1895							1986	
					6096												3515							757	

C4

APPENDIX D

1100-EM-1 OPERABLE UNIT INCURRED COSTS

1100-EM-1 Drilling $

1100-EM-1	Drilling	Vadose	GW
Geosciences Support	107	30	77
Technical Support	65	40	25
Vadose Zone Drilling	200	200	
Vadose Zone Drilling KEH	105	105	
GW Monitoring Wells	67		67
GW Monitoring Wells KEH	510		510
NPO Support	11	9	2
HPT ~~RPT~~ Support	44	22	22
Analytical Systems	30	20	10
QA Support	15	10	5
Subtotal WHC	539	331	208
Subtotal KEH	[illegible]	[illegible]	[illegible]
25% G&A/CSP on WHC	674	414	260
6.5% CSP on KEH	655	112	543
Total	1329	526	803
Number of Holes		12	16
Footage		317	1149

WORK PLAN COST ANALYSIS

Work Plan WHC	CONTRACTOR	WHC MGT	TOTAL
100-HR-1	178	215	393
100-DR-1	187	100	287
100-NR-1	200	120	320
100-NR-3	300	120	420
100-KR-1	250	120	370
100-KR-4	230	120	350
1100-EM-1	111	205	316
200-BP-1	181	155	336
300-FF-1	175	120	295
AVG COST PER WORK PLAN			338

Work Plan WHC	PNL	WHC MGT	TOTAL
100-HR-3	506	104	610
300-FF-5	291	120	411
AVG COST PER WORK PLAN			511

WORK PLANS EMO*	EMO	WHC MGT	TOTAL
100-BC-1*	416	120	536
100-BC-5*	413	120	533
100-FR-1	477	120	597
AVG COST PER WORK PLAN			555

Costs include the production of the Work Plan and reviews up to the issuance to the regulators.

*Issued under the new Work Plan streamlining process. Parallel DOE and Regulator review save approximately 2 months and 50K Per Work Plan.

1100EM-1 COST ANALYSIS

Sample Analyzed	
Groundwater sample	45
Vadose and waste samples	346
Total Samples Taken	391
Total cost as of 5-31-90	$813

Field Sampling Costs	
Manpower	130
Misc. supplies	10
Overheads	36
Total (Also included in the Drilling Costs)	$176

Total Sampling Cost as of 5-31-90	$989
Cost per sample	$2.5K

Not all sampling cost have been recored to date
Commerical Analytical Labs Used

SURFACE INVESTIGATIONS	
Physical and Geophysical Surveys	277
Radiation Surveys	52
Biota Surveys	13
Air Monitoring	67
Reconnassance	8
Total	$417

APPENDIX E

KEH COST ESTIMATE FOR THE 15M DESIGN

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY

DATE 05/04/90 07:25
BY GDC LGH DKH

KEHR01 - PROJECT COST SUMMARY

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	1,750,000	22	390,000	2,140,000
	(ADJUSTED TO MEET DOE 5100.4)	-50,000		10,000	-40,000
460	IMPROVEMENTS TO LAND	300,000	25	70,000	370,000
501	BUILDINGS	940,000	25	240,000	1,180,000
550	OTHER STRUCTURES	1,580,000	25	390,000	1,970,000
600	UTILITIES	550,000	25	140,000	690,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	7,000,000	21	1,490,000	8,490,000
	(ADJUSTED TO MEET DOE 5100.4)	30,000		-30,000	0
	PROJECT TOTAL	12,100,000	22	2,700,000	14,800,000

E1

TYPE OF ESTIMATE	CONCEPTUAL	MAY 5,1990	REMARKS: CHECK
ARCHITECT ENGINEER	GDC 9/90		
OPERATING CONTRACTOR			

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

WBS	DESCRIPTION	ESTIMATE SUB TOTAL	OTHER INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
110000	DEFINITIVE DESIGN ONSITE A/E	325176	0	325176	6.88	22372	347548	15	52132	399680
120000	FIELD ENGR/INSPEC. ONSITE A/E	122700	0	122700	12.91	15841	138541	15	20781	159322
	SUBTOTAL 1 ENGINEERING	447876	0	447876	8.53	38213	486089	15	72913	559002
210000	PROCUREMENT - ONSITE A/E	60283	0	60283	6.88	4147	64431	20	12886	77317
	SUBTOTAL 2 PROCUREMENT	60283	0	60283	6.88	4147	64431	20	12886	77317
310000	24" HDPE TIE IN	33488	0	33488	12.91	4323	37812	32	11958	49769
310001	COLLECTION SUMP #1	601722	0	601722	12.91	77682	679404	25	168589	847993
310002	6" ABOVE GROUND EFFLUENT	149008	0	149008	12.91	19237	168244	25	42061	210306
	SUBTOTAL 31 CONST. ONSITE CONSTRUCTOR	784217	0	784217	12.91	101242	885460	25	222608	1108068
320001	DESIGN OF TEDF BY D/C CONTRACTOR	647500	99175	746675	13.81	103116	849791	25	212448	1062239
320002	ENGR/INSPEC. BY D/C CONTRACTOR	323700	42081	365781	13.81	50514	416295	25	104074	520369
321000	SITE WORK	507706	66649	574355	13.81	79318	653673	25	163418	817091
322000	DIVERSION BASIN 1 & 2	799238	103901	903139	13.81	124724	1027863	25	256966	1284828
323000	SUMP NO. 2	148942	19363	168305	13.81	23243	191548	25	47887	239435
324000	SUMP NO. 3	143628	18672	162299	13.81	22414	184713	25	46178	230891
325000	VALVE PITS	213922	27810	241732	13.81	33383	275115	25	68779	343894
326000	UNDERGROUND PIPING	49721	6464	56184	13.81	7759	63943	25	15986	79929
327101	FACILITY - PROCESS TREATMENT AREA	311762	40529	352291	13.81	48651	400942	23	93573	494515
327102	PROCESS TREATMENT MECH.	3596143	467499	4063642	13.81	561189	4624831	20	939096	5563927
327103	TREATMENT FACILITY ELECTRICAL	284436	36977	321412	13.81	44387	365799	25	91450	457249
327201	FACILITY - OPERATIONS AREA	96766	12580	109346	13.81	15101	124446	22	27845	152292
327202	OPERATIONS AREA MECH.	85337	11094	96430	13.81	13317	109747	35	38412	148159
327203	OPERATIONS FACILITY ELECTRICAL	217172	28232	245405	13.81	33890	279295	25	69824	349119
328000	DISCHARGE LINE	20948	2723	23672	13.81	3269	26941	25	6735	33676
	SUBTOTAL 32 CONSTRUCTION OFFSITE D/C	7446922	983747	8430668	13.81	1164275	9594944	23	2182670	11777614
330000	OPERATING CONTRACTOR	79251	0	79251	12.46	9875	89126	25	22281	111407
	SUBTOTAL 33 OPERATING CONTRACTOR	79251	0	79251	12.46	9875	89126	25	22281	111407
340000	PROJECT MANAGEMENT	878000	0	878000	12.46	109399	987399	20	197480	1184879
	SUBTOTAL 34 PROJECT MANAGEMENT OPER.CONTR.	878000	0	878000	12.46	109399	987399	20	197480	1184879

WBS	DESCRIPTION	ESTIMATE SUB TOTAL	OTHER INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
	SUBTOTAL 3 CONSTRUCTION	9188390	983747	10172137	13.61	1384791	11556928	23	2625039	14181967
	PROJECT TOTAL	9,696,549	983,747	10,680,296	13.36	1,427,151	12,107,447	22	2,710,838	14,818,286

E3

R ENGINEERS HANFORD
NGHOUSE HANFORD COMPANY
O. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR03 - ESTIMATE BASIS SHEET

DATE 05/03/90 07:06
BY GDC LGH DKH

CUMENTS AND DRAWINGS
====================
CUMENTS: FUNCTIONAL DESIGN CRITERIA, WHC-SD-L045H-FDC-001, "DRAFT"
CONCEPTUAL DESIGN REPORT, WHC-SD-L045H-CDR-001, "PRELIMINARY"

AWINGS : ES-L045H-A1,H1,M1 THRU M5

TERIAL PRICES
============
IT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL. VENDOR INFORMATION WAS OBTAINED FOR THE FOLLOWING ITEMS:
(THE VENDOR INFORMATION SHEETS ARE STILL BEING DEVELOPED)

BOR RATES
=========
RRENT HANFORD BASE RATES AS ISSUED BY KEH (ISSUE # 13, REV. 0, DATED 2-1-90) INCLUDE FRINGE BENEFITS,
BOR INSURANCE, TAXES AND TRAVEL WHERE APPLICABLE.

NERAL REQUIREMENTS/TECHNICAL SERVICES
=====================================
A.) ONSITE CONSTRUCTION FORCES GENERAL REQUIREMENTS AND TECHNICAL SERVICES COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE KEH ESTIMATING FACTOR/BILLING SCHEDULE REVISION 10 DATED JANUARY 2, 1990. THE TOTAL COMPOSITE PERCENTAGE APPLIED TO ONSITE CONSTRUCTION FORCES LABOR FOR THIS PROJECT IS 72 TO 79% FOR SHOP WORK AND 102 TO 109% FOR FIELD WORK WHICH IS REFLECTED IN THE "OH&P / B & I" COLUMN OF THE ESTIMATE DETAIL.
B.) FIXED PRICE CONTRACTOR OVERHEAD, PROFIT, BOND AND INSURANCE COSTS HAVE BEEN APPLIED AT THE FOLLOWING PERCENTAGES AND ARE REFLECTED IN THE "OH&P / B & I" COLUMN OF THE ESTIMATE DETAIL:

LABOR & MATERIAL @ 15% OVERHEAD & 10% PROFIT,B & I ; SUBCONTRACTS @ 5%

CALATION
========
CALATION CALCULATED BY THE HANFORD MATERIAL & LABOR ESCALATION STUDY, JANUARY 1990.

UNDING - LINE ITEMS:
====================
S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE J-2 SUBPARAGRAPH (M), REQUIRES ROUNDING OF A COST ESTIMATE
$10,000 FOR ITEM COST AND $100,000 FOR TOTAL COST. REFERENCE: DOE 5100.4, FIGURE I-11, DATED 10-31-84.

E4

7. REMARKS
=======

A.) AS OF DECEMBER 1, 1989, QUALITY SUPPORT AND SAFETY FOR CONSTRUCTION FORCES ARE INCLUDED IN THE CRAFT ADDER.

B.) THIS ESTIMATE IS BASED ON THE FOLLOWING METHOD OF PERFORMANCE:

. THE ONSITE A/E WILL PERFORM DEFINITIVE DESIGN, ENGINEERING/INSPECTION AND PROCUREMENT FOR THE SUMP #1,TIE-IN TO EXISTING SEWER, AND NEW PIPING THRU THE CONTAMINATED AREA ALONG THE EXISTING CRIB.

. THE ONSITE CONSTRUCTION CONTRACTOR WILL PERFORM ALL CONSTRUCTION ACTIVITIES DESIGNED BY THE ONSITE A/E.

. THE OFFSITE DESIGN/CONTRUCT CONTRACTOR WILL PERFORM ALL DESIGN, INSPECTION, AND CONSTRUCTION FOR THE T.E.D.F., RETENTION BASINS, SUMPS, VLAVE PITS, AND INTERCONNECTING PIPING.

. THE CONTRACT PLACEMENT AND CONTRACT MANAGEMENT FOR THE DESIGN/CONSTRUCT CONTRACT WILL BE PERFORMED BY THE ONSITE CONSTRUCTION CONTRACTOR.

. OVERALL PROJECT MANAGEMENT WILL BE THE RESPONSIBLITY OF THE OPERTING CONTRACTOR.

C.) DUE TO THE LEVEL OF DESIGN INFORMATION AVALIABLE NUMEROUS ASSUMPTIONS WERE MADE. THE FOLLOWING ARE THE ASSUMPTIONS THAT HAVE THE LARGEST IMPACT TO THE PROJECT COSTS.

. ASSUMED MOST PIPE AND ELECTRICAL QUAINTIES, LENGTHS, SIZES, AND LOADS FOR THE TREATMENT FACILITY.

. ASSUMED 316' OF TRENCHES AT 2'X 3'DEEP AND A 10' X 12' X 10'DEEP CATCH TANK SUMP FOR THE PROCESS AREA.

. ALLOWANCES WERE MADES FOR THE MINOR IMPROVEMENTS TO THE EXISTING ROAD.

. ALLOWANCES WERE MADE FOR PENETRATIONS IN THE LINER SYSTEM.

. ASSUMED EXCAVATION 3' BELOW THE BOTTOM ELEVATION SHOWN ON THE RETENTION BASIN PLAN IN ORDER TO ALLOW FOR THE LAYER OF CLAY.

. ASSUMED DEPTH OF EXCAVATION FOR THE SUMPS, VALVE PITS, AND UNDERGROUND PIPING.

. ASSUMED DISPOSAL FACILITY ELECTRICAL LOAD 1500 KVA OF THAT LOAD THE EVAPORATOR IS 645 KVA AND THE ELECTRIC BOILER IS 450 KVA.

. ASSUMED PROGRAMMABLE CONTROLLER CONTROLS THE PROCESS SYSTEM INCLUDING THE EVAPORATOR,STEAM GENERATOR AND RO SYSTEM.

E5

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR04 - COST CODE ACCOUNT SUMMARY

DATE 05/04/90 07:25
BY GDC LGH DKH

COST CODE	WBS DESCRIPTION	ESTIMATE SUB TOTAL	OTHER INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING									
110000	DEFINITIVE DESIGN ONSITE A/E	325176	0	325176	6.88	22372	347548	15	52132	399680
120000	FIELD ENGR/INSPEC. ONSITE A/E	122700	0	122700	12.91	15841	138541	15	20781	159322
320001	DESIGN OF TEDF BY D/C CONTRACTOR	647500	99175	746675	13.81	103116	849791	25	212448	1062239
320002	ENGR/INSPEC. BY D/C CONTRACTOR	323700	42081	365781	13.81	50514	416295	25	104074	520369
TOTAL 000	ENGINEERING	1419076	141256	1560332	12.30	191843	1752175	22	389435	2141610
460	IMPROVEMENTS TO LAND									
321000	SITE WORK	231077	30040	261117	13.81	36060	297177	25	74294	371471
TOTAL 460	IMPROVEMENTS TO LAND	231077	30040	261117	13.81	36060	297177	25	74294	371471
501	BUILDINGS									
310001	COLLECTION SUMP #1	156303	0	156303	12.91	20179	176481	25	44120	220602
321000	SITE WORK	15737	2046	17783	13.81	2456	20239	25	5060	25299
327101	FACILITY - PROCESS TREATMENT AREA	311762	40529	352291	13.81	48651	400942	23	93573	494515
327103	TREATMENT FACILITY ELECTRICAL	37004	4811	41815	13.81	5775	47589	25	11897	59486
327201	FACILITY - OPERATIONS AREA	96766	12580	109346	13.81	15101	124446	22	27845	152292
327202	OPERATIONS AREA MECH.	85337	11094	96430	13.81	13317	109747	35	38412	148159
327203	OPERATIONS FACILITY ELECTRICAL	46059	5988	52046	13.81	7188	59234	25	14808	74042
TOTAL 501	BUILDINGS	748967	77046	826014	13.64	112666	938680	25	235715	1174395
550	OTHER STRUCTURES									
210000	PROCUREMENT - ONSITE A/E	60283	0	60283	6.88	4147	64431	20	12886	77317
310001	COLLECTION SUMP #1	254692	0	254692	12.91	32881	287572	25	70631	358203
322000	DIVERSION BASIN 1 & 2	748759	97339	846098	13.81	116846	962944	25	240736	1203680
323000	SUMP NO. 2	34578	4495	39073	13.81	5396	44469	25	11117	55586
324000	SUMP NO. 3	34578	4495	39073	13.81	5396	44469	25	11117	55586
325000	VALVE PITS	133350	17336	150686	13.81	20810	171495	25	42874	214369

COST CODE	WBS DESCRIPTION	ESTIMATE SUB TOTAL	OTHER INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
TOTAL 550	OTHER STRUCTURES	1266240	123664	1389905	13.34	185476	1575381	25	389362	1964742
600	UTILITIES									
310001	COLLECTION SUMP #1	172450	0	172450	12.91	22263	194713	25	48678	243391
321000	SITE WORK	260892	34563	295455	13.81	40802	336257	25	84064	420321
330000	OPERATING CONTRACTOR	15000	0	15000	12.46	1869	16869	25	4217	21086
TOTAL 600	UTILITIES	448342	34563	482905	13.45	64935	547839	25	136960	684799
700	SPECIAL EQUIP/PROCESS SYSTEMS									
310000	24" HDPE TIE IN	33488	0	33488	12.91	4323	37812	32	11958	49769
310001	COLLECTION SUMP #1	18278	0	18278	12.91	2360	20637	25	5159	25796
310002	6" ABOVE GROUND EFFLUENT	149008	0	149008	12.91	19237	168244	25	42061	210306
322000	DIVERSION BASIN 1 & 2	50479	6562	57041	13.81	7877	64919	25	16230	81148
323000	SUMP NO. 2	114365	14867	129232	13.81	17847	147079	25	36770	183849
324000	SUMP NO. 3	109050	14176	123226	13.81	17018	140244	25	35061	175305
325000	VALVE PITS	80572	10474	91047	13.81	12574	103620	25	25905	129525
326000	UNDERGROUND PIPING	49721	6464	56184	13.81	7759	63943	25	15986	79929
327102	PROCESS TREATMENT MECH.	3596143	467499	4063642	13.81	561189	4624831	20	939096	5563927
327103	TREATMENT FACILITY ELECTRICAL	247431	32166	279598	13.81	38612	318210	25	79552	397762
327203	OPERATIONS FACILITY ELECTRICAL	171114	22245	193358	13.81	26703	220061	25	55015	275077
328000	DISCHARGE LINE	20948	2723	23672	13.81	3269	26941	25	6735	33676
330000	OPERATING CONTRACTOR	64251	0	64251	12.46	8006	72257	25	18064	90321
340000	PROJECT MANAGEMENT	878000	0	878000	12.46	109399	987399	20	197480	1184879
TOTAL 700	SPECIAL EQUIP/PROCESS SYSTEMS	5582847	577177	6160024	13.57	836172	6996196	21	1485072	8481269
PROJECT TOTAL		9,696,549	983,747	10,680,296	13.36	1,427,151	12,107,447	22	2,710,838	14,818,286

KEHR05 - ESTIMATE SUMMARY BY CSI DIVISION

CSI DIV	DESCRIPTION	ESTIMATE SUB TOTAL	OTHER INDIRECTS	SUB TOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
ENGINEERING										
00	TECHNICAL SERVICES	1419076	141256	1560332	12.30	191843	1752175	22	389435	2141610
	TOTAL ENGINEERING	1419076	141256	1560332	12.30	191843	1752175	22	389435	2141610
CONSTRUCTION										
02	SITEWORK	1246284	128069	1374353	13.62	187181	1561534	25	394329	1955863
03	CONCRETE	613332	60162	673494	13.61	91655	765149	25	191287	956436
04	MASONRY	14280	1856	16136	13.81	2228	18365	25	4591	22956
05	METALS	29165	2910	32075	13.62	4368	36443	25	9111	45554
07	MOISTURE AND THERMAL CONTROL	3077	400	3477	13.81	480	3957	25	989	4947
08	DOORS, WINDOWS AND GLASS	23248	3022	26271	13.81	3628	29899	25	7475	37373
09	FINISHES	73649	6595	80244	13.55	10876	91120	24	21486	112606
10	SPECIALTIES	7587	986	8573	13.81	1184	9757	25	2439	12197
11	EQUIPMENT	3522896	457976	3980872	13.81	549758	4530631	20	906126	5436757
13	SPECIAL CONSTRUCTION	186921	21056	207977	13.70	28497	236475	20	47781	284256
15	MECHANICAL	387255	40539	427793	12.80	54764	482558	29	137813	620371
16	ELECTRICAL	1291780	118917	1410697	13.56	191289	1601986	25	400497	2002483
19	PROJECT MANAGEMENT	878000	0	878000	12.46	109399	987399	20	197480	1184879
	TOTAL CONSTRUCTION	8277473	842491	9119964	13.55	1235309	10355273	22	2321404	12676676
PROJECT TOTAL		9,696,549	983,747	10,680,296	13.36	1,427,151	12,107,447	22	2,710,838	14,818,286

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** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR07 - ONSITE INDIRECT COSTS BY WBS

WBS	DESCRIPTION	ESTIMATE SUB TOTAL	CONTRACT %	ADMINISTRATION TOTAL	BID PACK PREP.	OTHER INDIRECTS	TOTAL INDIRECTS
110000	DEFINITIVE DESIGN ONSITE A/E	325176	0.00	0	0	0	0
120000	FIELD ENGR/INSPEC. ONSITE A/E	122700	0.00	0	0	0	0
210000	PROCUREMENT - ONSITE A/E	60283	0.00	0	0	0	0
310000	24" HDPE TIE IN	33488	0.00	0	0	0	0
310001	COLLECTION SUMP #1	601722	0.00	0	0	0	0
310002	6" ABOVE GROUND EFFLUENT	149008	0.00	0	0	0	0
320001	DESIGN OF TEDF BY D/C CONTRACTOR	647500	13.00	84175	15000	0	99175
320002	ENGR/INSPEC. BY D/C CONTRACTOR	323700	13.00	42081	0	0	42081
321000	SITE WORK	507706	13.13	66649	0	0	66649
322000	DIVERSION BASIN 1 & 2	799238	13.00	103901	0	0	103901
323000	SUMP NO. 2	148942	13.00	19363	0	0	19363
324000	SUMP NO. 3	143628	13.00	18672	0	0	18672
325000	VALVE PITS	213922	13.00	27810	0	0	27810
326000	UNDERGROUND PIPING	49721	13.00	6464	0	0	6464
327101	FACILITY - PROCESS TREATMENT AREA	311762	13.00	40529	0	0	40529
327102	PROCESS TREATMENT MECH.	3596143	13.00	467499	0	0	467499
327103	TREATMENT FACILITY ELECTRICAL	284436	13.00	36977	0	0	36977
327201	FACILITY - OPERATIONS AREA	96766	13.00	12580	0	0	12580
327202	OPERATIONS AREA MECH.	85337	13.00	11094	0	0	11094
327203	OPERATIONS FACILITY ELECTRICAL	217172	13.00	28232	0	0	28232
328000	DISCHARGE LINE	20948	13.00	2723	0	0	2723
330000	OPERATING CONTRACTOR	79251	0.00	0	0	0	0
340000	PROJECT MANAGEMENT	878000	0.00	0	0	0	0
PROJECT TOTAL		9,696,549		968,747	15,000	0	983,747

E3

KAISER ENGINEERS HANFORD

ED&I COST ESTIMATE SUMMARY

Title	Rev	Date
L-045H 300 AREA TEDF	0	03-May-90

Work Order No.	Client	Contractor	Prepared By	KEH Approvals
ER 0164	M. Carrigan	WHC	V.T. Smith	

DISCIPLINE		DEFINITIVE DESIGN DRAWINGS	DEFINITIVE DESIGN MANHOURS		ENGR/INSP MANHOURS
CIVIL	(21)	6	790		300
ENVIRONMENTAL ENGRG	(22)	2	1052		300
ARCHITECTURAL	(23)		0		0
STRUCTURAL	(24)		0		0
NUCLEAR EQUIPMENT	(25)		0		0
FIRE PROTECTION	(26)		40		20
SAFETY REVIEW	(26.3)		40		20
PIPING & VESSELS	(27)	6	940		350
HVAC	(28)		0		0
INSTRUMENTATION	(29)		0		0
SAFEGUARDS & SECURITY	(30)		0		0
ELECTRICAL	(31)	6	800		105
SPECIFICATIONS	(32)		50		10
SPECIALTY ENGINEERING	(33)		0		0
CAD	(34)		0		0
DESIGN ADMINISTRATION	(35)		40		10
ENVIRONMENTAL COMPLIANCE	(39)		20		10
PROJECT MANAGEMENT	(40)		390		100
WORD PROCESSING	(41)		100		20
QUALITY ASSURANCE	(42)		40		10
ACCEPTANCE INSPECTION	(44)		40		560
PROJECT CONTROL	(45)		90		140
ESTIMATING	(46)		260		30
SCHEDULING	(47)		0		0
PUBLICATIONS	(48)		100		0
SUBCONTRACTS & PROCUREMENT	(49)		20		0
CF ADMINISTRATION	(60)		0		0
CM ADMINISTRATION	(61)		40		0
SURVEY/SCANNING	(62)		0		0
CONSTRUCTION ENGINEERING	(63)		160		0
SAFETY REP	(64)		0		0
RECORDS TURNOVER	(65)		60		60
AS-BUILTING	(66)		0		0
TOTAL DWGS TOTAL HOURS		20	5072	0	2045
RATE $/HR TOTAL $		$58.00	$294.176.00	$60.00	$122.700.00
GRAPHICS	(70-1)				
REPRODUCTIONS	(70-2)		$5.000.00		
PHOTOGRAPHY	(70-3)				
COMPUTER SERVICES	(70-4)		$4.000.00		
CALIBRATION	(70-5)				
OTHER SERVICES	(70-6)		$20.000.00		
RENT	(73-1)				
TRAVEL	(74-1)		$2.000.00		
SUBTOTAL			$323.176.00		$122.700.00
ESCALATION RATE	(71-1)	6.88	$22.372.00	12.91	$15.841.00
SUBTOTAL			$347.548.00		$138.541.00
CONTINGENCY	(72-1)	15	$52.132.00	15	$20,781.00
TOTAL COST			$399,680.00		$159,322.00

Remarks
ON-SITE (KEH) DEFINITIVE DESIGN COSTS
ON-SITE (KEH) ENGINEERING/INSPECTION COSTS

OTHER SERVICES INCLUDES $5520 CADD SURCHARGE (1840 HRS @ $3.00)

Distribution: Engr Doc Control Mgr Engr Mgr Proj Mgt Proj Control

L1DSN6U3JUN89

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
BY GDC LGH DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
110000	DEFINITIVE DESIGN ONSITE A/E										
110000.00	TECHNICAL SERVICES										
110000.0000001	DEFINITIVE DESIGN	000	1 LS	0	0	0	0	325176	0	0	325176
SUBTOTAL	TECHNICAL SERVICES			0	0	0	0	325,176	0	0	325,176
TOTAL	COST CODE 00000 WBS 110000			0	0	0	0	325,176	0	0	325,176
	(ESCALATION 6.88% - CONTINGENCY 15.00%)										
TOTAL WBS 110000	DEFINITIVE DESIGN ONSITE A/E			0	0	0	0	325,176	0	0	325,176

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
BY GDC LGH DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
120000	FIELD ENGR/INSPEC. ONSITE A/E										
120000.00	TECHNICAL SERVICES										
120000.0000001	ENGINEERING INSPECTION	000	1 LS	0	0	0	0	122700	0	0	122700
	SUBTOTAL TECHNICAL SERVICES			0	0	0	0	122,700	0	0	122,700
TOTAL	COST CODE 00000 WBS 120000			0	0	0	0	122,700	0	0	122,700
	(ESCALATION 12.91% - CONTINGENCY 15.00%)										
TOTAL WBS 120000 FIELD ENGR/INSPEC. ONSITE A/E				0	0	0	0	122,700	0	0	122,700

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KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

PAGE 0003
DATE 05/04/90 07:26
BY GDC LGH DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
210000	PROCUREMENT - ONSITE A/E										
210000.15	MECHANICAL										
210000.1500002	24" MOTOR OPERATED BUTTER FLY VALVE	550	F 1 EA	0	0	0	7500	0	0	0	7500
210000.1500004	5 HP PUMP GOULD MODEL VIT	550	F 2 EA	0	0	0	37000	0	0	0	37000
SUBTOTAL	MECHANICAL		(FIELD)	0	0	0	44,500	0	0	0	44,500
	CONSUMABLES 6.00%						2670				2670
	SALES TAX 7.80%						3679		0		3679
	WAREHOUSING 20.00%						9434				9434
TOTAL	COST CODE 55015 WBS 210000			0	0	0	60,283	0	0	0	60,283
	(ESCALATION 6.88% - CONTINGENCY 20.00%)										
TOTAL WBS 210000 PROCUREMENT - ONSITE A/E				0	0	0	60,283	0	0	0	60,283

E13

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
310000	24" HDPE TIE IN										
310000.02	SITEWORK										
310000.0200018	CUT INTO EXISTING 24" VCP	700	M 2 EA	12	373	0	100	0	0	380	853
SUBTOTAL	SITEWORK		(MASK)	12		0		0		380	
					373		100		0		853
	SWP 100.00%			12	373						373
	CONSUMABLES 6.00%						6				6
	SALES TAX 7.80%						8		0		8
	WAREHOUSING 20.00%						21				21
	OH&P / B&I (ON MARKUPS ONLY)									380	380
TOTAL	COST CODE 70002			24		0		0		760	
	WBS 310000				746		135		0		1,642
	(ESCALATION 12.91% - CONTINGENCY 35.00%)										
310000.0200010	FAB BURIAL BOXES	700	S 7 EA	224	5470	0	1400	0	0	3938	10808
SUBTOTAL	SITEWORK		(SHOP)	224		0		0		3,938	
					5,470		1,400		0		10,808
	CONSUMABLES 6.00%						84				84
	SALES TAX 7.80%						116		0		116
	WAREHOUSING 20.00%						297				297
TOTAL	COST CODE 70002			224		0		0		3,938	
	WBS 310000				5,470		1,897		0		11,305
	(ESCALATION 12.91% - CONTINGENCY 25.00%)										
310000.0200002	HAND EXCAVATION FOR 24" TIE IN TO EXISTING	700	W 36 CY	72	1492	0	0	0	0	1522	3014

E14

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
310000.0200004	SAND BEDDING	700 W	3 CY	2	41	0	30	0	0	42	113
310000.0200006	SELECT BACKFILL	700 W	11 CY	8	166	0	28	0	0	169	363
310000.0200008	COMMON BACKFILL	700 W	9 CY	5	104	0	0	0	0	106	210
310000.0200012	LOAD WASTE MATERIAL INTO BOXES (20% SWELL)	700 W	32 CY	48	995	0	0	0	0	1015	2010
310000.0200014	HAUL BOXES TO BURIAL SITE	700 W	7 BXS	5	118	0	0	0	0	120	238
310000.0200016	DAM 24" VCP AT UPSTREAM MH AND PUMP TO TRENCH VIA TEMPORARY LINE (ALLOW)	700 W	1 LS	40	1244	0	1000	0	0	1269	3513
310000.0200020	INSTALL 24" HDPE FLGD. WYE	700 W	1 EA	8	249	0	2500	0	0	254	3003
310000.0200022	24" HDPE PIPE	700 W	50 LF	25	777	0	1375	750	0	830	3732
310000.0200024	MISC. WORK, FLUSH, TEST AND TERRA TAPE	700 W	50 LF	13	404	0	63	0	0	412	879
SUBTOTAL SITEWORK		(SWP)		226	5,590	0	4,996	750	0	5,739	17,075
	SWP 15.00%			34	839						839
	CONSUMABLES 6.00%						300				300
	SALES TAX 7.80%						413		0		413
	WAREHOUSING 20.00%						1059				1059
	OH&P / B&I (ON MARKUPS ONLY)									855	855
TOTAL	COST CODE 70002 WBS 310000			260	6,429	0	6,768	750	0	6,594	20,541

(ESCALATION 12.91% - CONTINGENCY 35.00%)

		MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL WBS 310000 24" HDPE TIE IN		508	12,645	0	8,800	750	0	11,293	33,487

ACCOUNT NUMBER	DESCRIPTION	COST CODE		QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
310001	COLLECTION SUMP #1											
310001.02	SITEWORK											
310001.0200002	MACHINE EXCAVATION FOR SUMP NO. 1	550	F	1000 CY	170	4015	0	0	0	0	4095	8110
310001.0200004	BACKFILL AND COMPACT	550	F	944 CY	283	6684	0	0	0	0	6818	13502
SUBTOTAL SITEWORK			(FIELD)		453	10,699	0	0	0	0	10,913	21,612
TOTAL	COST CODE 55002 WBS 310001				453	10,699	0	0	0	0	10,913	21,612
	(ESCALATION 12.91% - CONTINGENCY 25.00%)											
310001.0200003	HAND EXCAVATION	550	W	204 CY	204	4227	0	0	0	0	4312	8539
310001.0200005	HAUL TO BURIAL	550	W	204 CY	61	1264	0	0	0	0	1289	2553
SUBTOTAL SITEWORK			(SWP)		265	5,491	0	0	0	0	5,601	11,092
	SWP 15.00%				40	824						824
	OH&P / B&I (ON MARKUPS ONLY)										840	840
TOTAL	COST CODE 55002 WBS 310001				305	6,315	0	0	0	0	6,441	12,756
	(ESCALATION 12.91% - CONTINGENCY 35.00%)											
310001.03	CONCRETE											
310001.0300002	GRADE AND SCREED SOG	550	F	679 SF	7	145	0	68	0	0	148	361
310001.0300004	FORM SOG	550	F	145 LF	35	855	0	181	0	0	872	1908
310001.0300006	FORM WALLS, SUMP	550	F	2208 SF	530	12943	0	2760	0	0	13202	28905

E16

ACCOUNT NUMBER	DESCRIPTION	COST CODE		QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
310001.0300008	FORM WALLS, VALVE PIT	550	F	319 SF	77	1880	0	399	0	0	1918	4197
310001.0300010	FORM WALLS, BUILDING	550	F	408 SF	98	2393	0	510	0	0	2441	5344
310001.0300012	FORM SUSP. SLAB	550	F	448 SF	672	16410	0	560	0	0	16738	33708
310001.0300014	KEY JOINTS	550	F	316 LF	16	391	0	158	0	0	399	948
310001.0300016	STRIP AND OIL	550	F	3528 SF	106	2257	0	882	0	0	2302	5441
310001.0300018	CONCRETE, SOG	550	F	27 CY	27	645	0	1485	0	0	658	2788
310001.0300020	CONCRETE, SUMP WALLS	550	F	42 CY	53	1266	0	2310	0	0	1291	4867
310001.0300022	CONCRETE, VALVE PIT WALLS	550	F	5 CY	6	143	0	275	0	0	146	564
310001.0300024	CONCRETE, BUILDING WALLS	550	F	4 CY	5	119	0	220	0	0	121	460
310001.0300026	CONCRETE, SUSP. SLAB	550	F	17 CY	17	406	0	935	0	0	414	1755
310001.0300027	SUMP LINER	550	F	968 SF	484	11563	0	9680	0	0	11794	33037
310001.0300028	CURING	550	F	4731 SF	24	573	0	71	0	0	584	1228
310001.0300030	REBAR @ 140#/CY	550	F	13300 LBS	199	5395	0	3724	0	0	5503	14622
310001.0300032	WATER STOP	550	F	111 LF	10	233	0	999	0	0	238	1470
	SUBTOTAL CONCRETE			(FIELD)	2,366	57,617	0	25,217	0	0	58,769	141,603
	CONSUMABLES 6.00%							1513				1513
	SALES TAX 7.80%							2085		0		2085
	WAREHOUSING 20.00%							5346				5346
TOTAL	COST CODE 55003 WBS 310001				2,366	57,617	0	34,161	0	0	58,769	150,547

(ESCALATION 12.91% - CONTINGENCY 25.00%)

310001.05 METALS

ACCOUNT NUMBER	DESCRIPTION	COST CODE		QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
310001.0500002	ACCESS LADDER	550	F	24 LF	24	651	0	1440	0	0	664	2755
310001.0500004	3' X 3' ACCESS HATCH (ALLOW)	550	F	1 EA	16	434	0	500	0	0	443	1377
310001.0500006	4' X 5' PIT COVER (ALLOW)	550	F	1 EA	16	434	0	800	0	0	443	1677
	SUBTOTAL METALS			(FIELD)	56	1,519	0	2,740	0	0	1,550	5,809
	CONSUMABLES 6.00%							164				164
	SALES TAX 7.80%							227		0		227
	WAREHOUSING 20.00%							581				581

E17

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL	COST CODE 55005 WBS 310001			56	1,519	0	3,712	0	0	1,550	6,781
	(ESCALATION 12.91% - CONTINGENCY 25.00%)										
310001.09	FINISHES										
310001.0900002	WATERPROOF SUMP EXTERIOR	550	F 1378 SF	96	2130	0	1791	0	0	2173	6094
310001.0900004	SPC INTERIOR CONCRETE	550	F 2624 SF	184	4083	0	3936	0	0	4165	12184
310001.0900006	MISC. PAINTING (ALLOW)	550	F 1 LS	40	888	0	600	0	0	906	2394
SUBTOTAL	FINISHES		(FIELD)	320	7,101	0	6,327	0	0	7,244	20,672
	CONSUMABLES 6.00%						380				380
	SALES TAX 7.80%						523		0		523
	WAREHOUSING 20.00%						1341				1341
TOTAL	COST CODE 55009 WBS 310001			320	7,101	0	8,571	0	0	7,244	22,916
	(ESCALATION 12.91% - CONTINGENCY 20.00%)										
310001.13	SPECIAL CONSTRUCTION										
310001.1300002	PRE-ENGINEERED METAL BLDG.	550	F 594 SF	0	0	0	0	23760	0	1188	24948
SUBTOTAL	SPECIAL CONSTRUCTION		(FIELD)	0	0	0	0	23,760	0	1,188	24,948
TOTAL	COST CODE 55013 WBS 310001			0	0	0	0	23,760	0	1,188	24,948
	(ESCALATION 12.91% - CONTINGENCY 20.00%)										

E18

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
310001.15	MECHANICAL										
310001.1500002	24" MOTOR OPERATED BUTTER FLY VALVE	550 F	1 EA	6	187	0	0	0	0	191	378
310001.1500004	5 HP PUMP GOULD MODEL VIT	550 F	2 EA	48	1493	0	0	0	0	1523	3016
310001.1500006	24" FLANGES AND B,N & G SETS	550 F	2 EA	8	249	0	1500	0	0	254	2003
310001.1500008	6" MOTOR OPERATED BUTTER FLY VALVE	550 F	2 EA	3	93	0	1500	0	0	95	1688
310001.1500010	6" CHECK VALVE	550 F	2 EA	2	62	0	738	0	0	63	863
310001.1500012	6" FLEX CONNECTOR	550 F	2 EA	4	124	0	150	0	0	126	400
310001.1500014	6" GATE VALVE	550 F	1 EA	1	31	0	300	0	0	32	363
310001.1500016	6" PIPE AND FITTINGS	550 F	1 LS	40	1244	0	1000	0	0	1269	3513
310001.1500018	LEVEL ELEMENT	550 F	1 EA	2	62	0	250	0	0	63	375
310001.1500020	PRESSURE INDICATOR	550 F	2 EA	3	93	0	200	0	0	95	388
SUBTOTAL	MECHANICAL	(FIELD)		117		0		0		3,711	
					3,638		5,638		0		12,987
	GENERAL FOREMAN 2.00%			2	73						73
	CONSUMABLES 6.00%						338				338
	SALES TAX 7.80%						466		0		466
	WAREHOUSING 20.00%						1195				1195
	OH&P / B&I (ON MARKUPS ONLY)									74	74
TOTAL	COST CODE 55015			119		0		0		3,785	
	WBS 310001				3,711		7,638		0		15,134
	(ESCALATION 12.91% - CONTINGENCY 25.00%)										
310001.16	ELECTRICAL										
310001.1614703	*** BUILDING ***	501 F	0	0	0	0	0	0	0	0	0
310001.1639901	OUTLET WIRING - RECEPTACLE & SWITCH, COMPOSITE/GRS	501 F	594 SF	18	548	0	754	0	0	559	1861
310001.1639902	OUTLET WIRING - LIGHTING	501 F	594 SF	59	1798	0	1437	0	0	1834	5069

E19

ACCOUNT NUMBER	DESCRIPTION	COST CODE		QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	EXTERIOR, COMPOSITE/GRS											
310001.1642001	FIRE ALARM CND & WIRE	501	F	100 LF	20	609	0	134	0	0	621	1364
310001.1642030	MANUAL FIRE ALARM STATION	501	F	1 EA	2	61	0	50	0	0	62	173
310001.1642031	HEAT DETECTOR	501	F	1 EA	2	61	0	250	0	0	62	373
310001.1642033	FIRE ALARM GONG	501	F	1 EA	2	61	0	150	0	0	62	273
310001.1642036	SMOKE DETECTORS	501	F	1 EA	2	61	0	115	0	0	62	238
310001.1661001	KILOWATT HOUR/DEMAND METER	501	F	1 EA	16	487	0	1000	0	0	497	1984
310001.1661002	AUTOMATIC TRANSFER SWITCH 225A 480V 3 POLE	501	F	1 EA	8	244	0	9500	0	0	249	9993
310001.1662014	NQOB 100A M.B. 4 W 120/208V W/24 EA 20A 1P C.B.	501	F	1 EA	14	427	0	500	0	0	436	1363
310001.1662016	NEHB 225AF/225AT M.B. PNLBD 480Y/277 3 PH 4W W/3 EA 60AF/20AT 3P C.B.	501	F	1 EA	0	0	0	0	0	0	0	0
310001.1662017	1 EA 60AF/25AT 3P C.B. 2 EA 60AF/50AT 3P C.B.	501	F	1 EA	24	731	0	1930	0	0	746	3407
310001.1664104	15 KVA DRY-TYPE TFMR 3 PH 480V-208/120Y	501	F	1 EA	14	427	0	1146	0	0	436	2009
SUBTOTAL	ELECTRICAL	(FIELD)			181	5,515	0	16,966	0	0	5,626	28,107
	GENERAL FOREMAN 5.00%				9	276						276
	CONSUMABLES 6.00%							1018				1018
	SALES TAX 7.80%							1403		0		1403
	WAREHOUSING 20.00%							3597				3597
	OH&P / B&I (ON MARKUPS ONLY)										281	281
TOTAL	COST CODE 50116 WBS 310001				190	5,791	0	22,984	0	0	5,907	34,682

(ESCALATION 12.91% - CONTINGENCY 25.00%)

ACCOUNT NUMBER	DESCRIPTION	COST CODE		QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
310001.1614702	3-2" PVC CONDUITS IN CONCRET ENCASED DUCT BANK COMPLETE FA,SIG & SPARE	501	W	1560 LF	1267	38603	0	12402	0	0	39375	90380
310001.1614704	MANHOLE 4' X 4' X 4' FOR ENCASED DUCT BANK FA,SIG & SPARE	501	W	3 EA	48	1462	0	1800	0	0	1491	4753
310001.1644010	5/8" STEEL GROUND CABLE	501	W	250 LF	10	305	0	113	0	0	311	729
310001.1644040	GROUND PLATE	501	W	2 EA	2	61	0	15	0	0	62	138

ACCOUNT NUMBER	DESCRIPTION	COST CODE		QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
310001.1644042	CADWELD & PATCH	501	W	18 EA	36	1097	0	180	0	0	1119	2396
310001.1644043	CONNECT TO BLDG STEEL	501	W	2 EA	4	122	0	20	0	0	124	266
310001.1644060	GROUND ROD STEEL 0.75" X 8'	501	W	4 EA	4	122	0	37	0	0	124	283
SUBTOTAL ELECTRICAL			(SWP)		1,371	41,772	0	14,567	0	0	42,606	98,945
	SWP 15.00%				206	6266						6266
	GENERAL FOREMAN 5.00%				79	2402						2402
	CONSUMABLES 6.00%							874				874
	SALES TAX 7.80%							1204				1204
	WAREHOUSING 20.00%							3088		0		3088
	OH&P / B&I (ON MARKUPS ONLY)										8841	8841
TOTAL	COST CODE 50116 WBS 310001				1,655	50,440	0	19,734	0	0	51,447	121,620

(ESCALATION 12.91% - CONTINGENCY 25.00%)

E21

ACCOUNT NUMBER	DESCRIPTION	COST CODE		QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
310001.1674101	FUSED CUTOUT WHC POWER INSTALL NORMAL POWER	600	F	3 EA	0	0	0	450	540	0	27	1017
310001.1674102	LIGHTNING ARRESTORS WHC INSTALL NORMAL POWER	600	F	3 EA	0	0	0	180	540	0	27	747
310001.1674104	4" POLE RISER NORMAL POWER	600	F	1 JOB	16	487	0	500	240	0	509	1736
310001.1674204	50 KVA TRANSFORMERS 13.8KVA-277V 1 PH NORMAL POWER	600	F	3 EA	0	0	0	3000	2880	0	144	6024
310001.1674300	3-4" PVC CONDUITS IN CONCRET ENCASED DUCT BANK COMPLETE BLDG 333 TO COLL BLDG	600	F	1300 LF	1391	42381	0	20397	0	0	43229	106007
310001.1674301	MANHOLE 4' X 4' X 4' FOR ENCASED DUCT BANK BLDG 333 TO COLL BLDG	600	F	3 EA	48	1462	0	1800	0	0	1491	4753
310001.1674302	#4 XLP NON-SHLD 1/C CU 5KV STANDBY POWER	600	F	3900 LF	78	2377	0	2059	0	0	2425	6861
310001.1674306	45 KVA XFMR 2400 - 480/277V INSTALL IN COLL BLDG	600	F	1 EA	36	1097	0	8374	0	0	1119	10590

AISER ENGINEERS HANFORD
ESTINGHOUSE HANFORD COMPANY
OB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
BY GDC LGH DKH

CCOUNT UMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
10001.1674308	BLDG 333 POWER 2400V ASSUME EXST C.B. TO TIE INTO	600	F 1 EA	24	731	0	300	0	0	746	1777
SUBTOTAL	ELECTRICAL		(FIELD)	1,593		0		4,200		49,717	
					48,535		37,060		0		139,512
	GENERAL FOREMAN 5.00%			80	2427						2427
	CONSUMABLES 6.00%						2224				2224
	SALES TAX 7.80%						3064		0		3064
	WAREHOUSING 20.00%						7857				7857
	OH&P / B&I (ON MARKUPS ONLY)									2475	2475
TOTAL	COST CODE 60016			1,673		0		4,200		52,192	
	WBS 310001				50,962		50,204		0		157,558

(ESCALATION 12.91% - CONTINGENCY 25.00%)

CCOUNT UMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
10001.1614701	*** UTILITY *** ZONE	600	W 0	0	0	0	0	0	0	0	0
10001.1614722	3-4" PVC CONDUITS IN CONCRET ENCASED DUCT BANK COMPLETE POLE #3 TO BLDG	600	W 100 LF	107	3260	0	1569	0	0	3325	8154
10001.1621123	#350 1/C THW STRANDED COPPE NORMAL POWER	600	W 500 LF	24	731	0	1809	0	0	746	3286
10001.1674103	POLE GROUNDING NORMAL POWER	600	W 1 JOB	6	183	0	100	0	0	187	470
SUBTOTAL	ELECTRICAL		(SWP)	137		0		0		4,258	
					4,174		3,478		0		11,910
	SWP 15.00%			21	626						626
	GENERAL FOREMAN 5.00%			8	240						240
	CONSUMABLES 6.00%						209				209
	SALES TAX 7.80%						288		0		288
	WAREHOUSING 20.00%						737				737
	OH&P / B&I (ON MARKUPS ONLY)									883	883
TOTAL	COST CODE 60016			165		0		0		5,141	
	WBS 310001				5,040		4,712		0		14,893

E22

AISER ENGINEERS HANFORD
/ESTINGHOUSE HANFORD COMPANY
IOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
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DATE 05/04/90 07:26
BY GDC LGH DKH

(ESCALATION 12.91% - CONTINGENCY 25.00%)

ACCOUNT NUMBER	DESCRIPTION	COST CODE		QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
10001.1610001	*** PROCESS *** CLEAN	700	F	0	0	0	0	0	0	0	0	0
10001.1610022	30A 4W FEEDER - 1/2" GRS WIT 4 #10 THHN CONDUCTORS	700	F	70 LF	8	244	0	119	0	0	249	612
10001.1610024	65A 4W FEEDER - 1" GRS WIT 4 #6 THHN CONDUCTORS	700	F	10 LF	2	61	0	32	0	0	62	155
10001.1610027	115A 4W FEEDER - 1 1/4" GRS 4 #2 THHN CONDUCTORS	700	F	90 LF	20	609	0	533	0	0	621	1763
10001.1610032	230A 4W FEEDER - 2" GRS 4 #4/0 THHN CONDUCTORS	700	F	60 LF	20	609	0	826	0	0	621	2056
10001.1625007	2/C #14 ALPHA SHIELDED SINGLE PAIR	700	F	2100 LF	42	1280	0	1743	0	0	1306	4329
10001.1638701	480V 1.5KW EVAPORATOR COOLER CONNECTION	700	F	1 EA	1	30	0	9	0	0	31	70
10001.1638702	480V 7.5KW UNIT HEATER INSTALL & CONNECTION	700	F	1 EA	4	122	0	500	0	0	124	746
10001.1668703	480V 5 HP MOTOR P-1,1A CONNECTION	700	F	2 EA	4	122	0	46	0	0	124	292
10001.1681004	INSTRM RACK	700	F	1 EA	8	244	0	1000	0	0	249	1493
10001.1682004	LE/LIT	700	F	1 EA	8	244	0	2000	0	0	249	2493
10001.1684004	HS/SC INCLUDED WITH VFD CONN CABLE	700	F	2 EA	1	30	0	10	0	0	31	71
10001.1684006	MOV-1,2,3 CONNECT	700	F	3 EA	3	91	0	75	0	0	93	259
10001.1684008	COND & WIRE ALLOWANCE INSTRM	700	F	150 LF	12	366	0	255	0	0	373	994
SUBTOTAL	ELECTRICAL	(FIELD)			133	4,052	0	7,148	0	0	4,133	15,333
	GENERAL FOREMAN 5.00%				7	203						203
	CONSUMABLES 6.00%							429				429
	SALES TAX 7.80%							591		0		591
	WAREHOUSING 20.00%							1515				1515
	OH&P / B&I (ON MARKUPS ONLY)										207	207
TOTAL	COST CODE 70016 WBS 310001				140	4,255	0	9,683	0	0	4,340	18,278

E23

(ESCALATION 12.91% - CONTINGENCY 25.00%)

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	TOTAL WBS 310001 COLLECTION SUMP #1			7,442	203,448	0	161,398	27,960	0	208,918	601,724

E24

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
BY GDC LGH DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
310002	6" ABOVE GROUND EFFLUENT										
310002.02	SITEWORK										
310002.0200122	FABRICATE BURIAL BOXES	700	S 5 BXS	160	3907	0	1000	0	0	3985	8892
SUBTOTAL SITEWORK			(SHOP)	160	3,907	0	1,000	0	0	3,985	8,892
	CONSUMABLES 6.00%						60				60
	SALES TAX 7.80%						83				83
	WAREHOUSING 20.00%						212		0		212
TOTAL	COST CODE 70002 WBS 310002			160	3,907	0	1,355	0	0	3,985	9,247
	(ESCALATION 12.91% - CONTINGENCY 25.00%)										
310002.0200110	HAND EXCAVATION FOR PIPE SUPPORTS FOR 6" ABOVE GRND. EFFLUENT	700	W 55 CY	110	2279	0	0	0	0	2325	4604
310002.0200112	SET PRECAST CONC. SUPPORTS	700	W 260 EA	86	1782	0	11700	0	0	1818	15300
310002.0200114	PIPE CUSHION AND ANCHOR	700	W 260 EA	52	1617	0	1300	0	0	1649	4566
310002.0200116	BACKFILL	700	W 35 CY	18	373	0	0	0	0	380	753
310002.0200118	LOAD WASTE MATERIAL INTO BOXES	700	W 23 CY	35	725	0	0	0	0	740	1465
310002.0200120	HAUL TO BURIAL SITE	700	W 5 BXS	5	118	0	0	0	0	120	238
310002.0200124	6" SCH. 80 PVC PIPE	700	W 1560 LF	234	7277	0	17160	0	0	7423	31860
310002.0200126	6" SCH. 80 PVC COUPLINGS	700	W 78 EA	0	0	0	3471	0	0	0	3471
310002.0200128	HEAT TRACE	700	W 1560 LF	78	2468	0	7800	0	0	2517	12785
310002.0200130	1 1/2" FIBERGLASS INSULATION	700	W 1560 LF	218	6294	0	5226	0	0	6420	17940
310002.0200132	ALUMINUM INSULATION JACKET	700	W 1560 LF	281	8112	0	3276	0	0	8274	19662
SUBTOTAL SITEWORK			(SWP)	1,117	31,045	0	49,933	0	0	31,666	112,644
	SWP 15.00%			168	4657						4657
	CONSUMABLES 6.00%						2996				2996
	SALES TAX 7.80%						4128				4128
	WAREHOUSING 20.00%						10586		0		10586
	OH&P / B&I (ON MARKUPS ONLY)									4750	4750

E25

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL	COST CODE 70002 WBS 310002			1,285	35,702	0	67,643	0	0	36,416	139,761
	(ESCALATION 12.91% - CONTINGENCY 25.00%)										
TOTAL WBS 310002 6" ABOVE GROUND EFFLUENT				1,445	39,609	0	68,998	0	0	40,401	149,008

E26

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
320001	DESIGN OF TEDF BY D/C CONTRACTOR										
320001.00	TECHNICAL SERVICES										
320001.0000002	DESIGN BY THE DESIGN/CONTUCT CONTR ALLOW 10% OF CONSTR.	000	1 LS	0	0	0	0	647500	0	0	647500
SUBTOTAL	TECHNICAL SERVICES			0	0	0	0	647,500	0	0	647,500
TOTAL	COST CODE 00000 WBS 320001			0	0	0	0	647,500	0	0	647,500
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
TOTAL WBS 320001	DESIGN OF TEDF BY D/C CONTRACTOR			0	0	0	0	647,500	0	0	647,500

E27

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
320002	ENGR/INSPEC. BY D/C CONTRACTOR										
320002.00	TECHNICAL SERVICES										
320002.0000003	ENGR/INSP. BY THE DESIGN/CONTUCT CONTR ALLOW 5% OF CONSTR.	000	1 LS	0	0	0	0	323700	0	0	323700
SUBTOTAL	TECHNICAL SERVICES			0	0	0	0	323,700	0	0	323,700
TOTAL	COST CODE 00000 WBS 320002			0	0	0	0	323,700	0	0	323,700

(ESCALATION 13.81% - CONTINGENCY 25.00%)

E28

TOTAL WBS 320002 ENGR/INSPEC. BY D/C CONTRACTOR	0	0	0	0	323,700	0	0	323,700	

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
321000	SITE WORK										
321000.02	SITEWORK										
321000.0201002	CLEAR & GRUB	460	4450 CY	0	0	0	0	5563	0	278	5841
321000.0201004	EXCAVATION 2.5'	460	37100 CY	0	0	0	0	46375	0	2319	48694
321000.0201006	FINE GRADING	460	44500 SY	0	0	0	0	13350	0	668	14018
321000.0201008	WATER FOR CONSTRUCTION	460	2250 M/G	0	0	0	0	11250	0	563	11813
321000.0201010	HAUL OFF WASTE	460	2500 CY	0	0	0	0	10000	0	500	10500
321000.0201011	8' HIGH CHAIN LINK FENCE WITH BARB WIRE	460	2000 LF	0	0	0	0	22000	0	1100	23100
321000.0201012	************* STABILIZATION *************	460	0	0	0	0	0	0	0	0	0
321000.0201014	FINE GRADING	460	32450 SY	0	0	0	0	9735	0	487	10222
321000.0201016	3" CRUSHED ROCK	460	5840 TON	0	0	0	0	61320	0	3066	64386
321000.0201018	WATER FOR CONSTRUCTION	460	1620 M/G	0	0	0	0	8100	0	405	8505
321000.0202002	FINE GRADING	460	5000 SY	0	0	0	0	1500	0	75	1575
321000.0202004	4" 1 1/4"-0 BASE COURSE	460	1125 TON	0	0	0	0	11250	0	563	11813
321000.0202006	2" 5/8"-0 LEVELING COURSE	460	560 TON	0	0	0	0	5880	0	294	6174
321000.0202008	WATER FOR CONSTRUCTION	460	250 M/G	0	0	0	0	1250	0	63	1313
321000.0202009	MINOR IMPROVEMENTS TO ENTRANCE ROAD (ALLOWANCE)	460	1 LS	0	0	0	0	12500	0	625	13125
SUBTOTAL	SITEWORK			0	0	0	0	220,073	0	11,006	231,079
TOTAL	COST CODE 46002 WBS 321000			0	0	0	0	220,073	0	11,006	231,079

(ESCALATION 13.81% - CONTINGENCY 25.00%)

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
321000.0200002	EXCAVATION AND BACKFILL FOR SANITARY WATER	600	170 CY	0	0	0	0	978	0	49	1027
321000.0200004	8" SCH 40 PVC PIPE	600	560 LF	39	1245	0	6160	0	0	1962	9367
321000.0200006	8" SCH 40 PVC FITTINGS	600	4 EA	2	64	0	540	0	0	160	764
321000.0200008	8" TIE IN TO EXISTING	600	1 EA	4	128	0	150	0	0	74	352
321000.0200010	MISC. WORK, FLUSH AND TEST	600	1 LS	4	128	0	25	0	0	41	194
321000.0200012	EXCAVATION AND BACKFILL FOR SANITARY SEWER	600	180 CY	0	0	0	0	1035	0	52	1087

CCOUNT UMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
21000.0200014	2" PVC PRESSURE PIPE	600	1020 LF	61	1947	0	1530	0	0	921	4398
21000.0200016	2" PVC FITTINGS	600	6 EA	2	64	0	78	0	0	38	180
21000.0200018	2" PVC CHECK VALVE	600	1 EA	1	32	0	35	0	0	18	85
21000.0200020	2" TIE IN TO EXISTING 4"	600	1 EA	2	64	0	25	0	0	24	113
21000.0200022	SEWAGE LIFT STATION ALLOW	600	1 EA	0	0	0	0	30000	0	1500	31500
21000.0200032	EXCAVATION AND BACKFILL FOR FIRE PROTECTION	600	40 CY	0	0	0	0	230	0	12	242
21000.0200034	FIRE PROTECTION PIPING	600	1 LS	80	2299	0	4800	0	0	1881	8980
21000.0200036	POST INDICATOR VALVE	600	1 EA	6	172	0	750	0	0	244	1166
21000.0200038	FIRE HYDRANTS	600	2 EA	16	460	0	2400	0	0	758	3618
SUBTOTAL	SITEWORK			217		0		32,243		7,734	
					6,603		16,493		0		63,073
	SALES TAX 7.80%						1286		0		1286
	OH&P / B&I (ON MARKUPS ONLY)									341	341
TOTAL	COST CODE 60002			217		0		32,243		8,075	
	WBS 321000				6,603		17,779		0		64,700

(ESCALATION 13.81% - CONTINGENCY 25.00%)

21000.16 ELECTRICAL

21000.1634004	LIGHT POLE ONE ARM W/LPS & PC 40' COMPLETE W/COND/WIRE	501	2 EA	60	1828	0	4400	0	0	1650	7878
21000.1644010	5/8" STEEL GROUND CABLE	501	1200 LF	48	1462	0	540	0	0	531	2533
21000.1644040	GROUND PLATE	501	4 EA	4	122	0	30	0	0	40	192
21000.1644042	CADWELD & PATCH	501	41 EA	82	2498	0	410	0	0	771	3679
21000.1644043	CONNECT TO BLDG STEEL	501	4 EA	8	244	0	40	0	0	75	359
21000.1644060	GROUND ROD STEEL 0.75" X 8'	501	11 EA	11	335	0	101	0	0	116	552
SUBTOTAL	ELECTRICAL			213		0		0		3,183	
					6,489		5,521		0		15,193
	SALES TAX 7.80%						431		0		431
	OH&P / B&I (ON MARKUPS ONLY)									114	114

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KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
BY GDC LGH DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL	COST CODE 50116 WBS 321000 (ESCALATION 13.81% - CONTINGENCY 25.00%)			213	6,489	0	5,952	0	0	3,297	15,738
321000.1610001	*** UTILITY *** YARD	6150	0	0	0	0	0	0	0	0	0
321000.1614702	3-2" PVC CONDUITS IN CONCRET ENCASED DUCT BANK COMPLETE FA,SIG & SPARE	6150	1720 LF	1032	0	0	13674	0	0	3624	17298
321000.1614722	3-4" PVC CONDUITS IN CONCRET ENCASED DUCT BANK COMPLETE POLE TO XFMER	6150	100 LF	79	2407	0	1569	0	0	1054	5030
321000.1614725	8-4" PVC CONDUITS IN CONCRET ENCASED DUCT BANK COMPLETE XFMR TO TF BLDG	6150	100 LF	145	4418	0	3462	0	0	2088	9968
321000.1621326	#600 XHHW 1/C COPPER 600V SWGR TO MCC-1 & MCC-2 NORMAL POWER	6150	2400 LF	115	3504	0	16874	0	0	5400	25778
321000.1622515	#2 EP/PVC GRD 1/C CU 15KV	6150	250 LF	6	185	0	442	0	0	166	793
321000.1626004	#4 ACSR 1/C WIRE "SWAN" POLE #14 TO POLE #17	6150	1800 LF	25	762	0	490	0	0	332	1584
321000.1626010	SIG CABLE	6150	10320 LF	248	7556	0	13127	0	0	5481	26164
321000.1629235	#2 15KV WIRE TERMINATION	6150	3 EA	9	274	0	105	0	0	100	479
321000.1665060	1500 KVA PAD MOUNT XFMR 13.8KV-480V 1 EA TIE BUS	6150	1 EA	0	0	0	0	0	0	0	0
321000.1665070	1 EA MAIN SWITCH 2000A 1 EA 1200A SWITCH MCC#1 1 EA 800A SWITCH MCC#2	6150	1 EA	0	0	0	0	0	0	0	0
321000.1665080	3 EA PROVISION 1 EA KWM	6150	1 EA	80	2437	0	67147	0	0	18440	88024
321000.1674006	45' CLASS 2 WOOD POLE	6150	3 EA	48	1462	0	675	0	0	566	2703
321000.1674101	FUSED CUTOUT	6150	3 EA	9	274	0	570	0	0	224	1068
321000.1674102	LIGHTNING ARRESTORS	6150	3 EA	9	274	0	270	0	0	144	688
321000.1674103	POLE GROUNDING	6150	1 JOB	6	183	0	100	0	0	75	358
321000.1674104	4" POLE RISER	6150	1 JOB	16	487	0	500	0	0	262	1249
321000.1674106	WOOD X-ARMS	6150	3 JOB	12	366	0	300	0	0	176	842
321000.1674107	DOWN GUY AND ANCHOR	6150	3 JOB	24	731	0	300	0	0	273	1304
321000.1674108	POLE HARDWARE	6150	3 JOB	18	548	0	270	0	0	217	1035

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KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
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CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
BY GDC LGH DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
SUBTOTAL	ELECTRICAL			1,881	25,868	0	119,875	0	0	38,622	184,365
	SALES TAX 7.80%						9350		0		9350
	OH&P / B&I (ON MARKUPS ONLY)									2478	2478
TOTAL	COST CODE 61516 WBS 321000			1,881	25,868	0	129,225	0	0	41,100	196,193
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
TOTAL WBS 321000 SITE WORK				2,311	38,960	0	152,956	252,316	0	63,478	507,710

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.CCOUNT 'UMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
22000	DIVERSION BASIN 1 & 2										
22000.02	SITEWORK										
22000.0200000	*** MASS EXCAVATION ***	550	0	0	0	0	0	0	0	0	0
22000.0200002	EXCAVATION CUT	550	6826 CY	0	0	0	0	8533	0	427	8960
22000.0200004	EXCAVATION FILL	550	46858 CY	0	0	0	0	58573	0	2929	61502
22000.0200010	** DIVERSION BASIN BASE **	550	0	0	0	0	0	0	0	0	0
22000.0200012	PUG MILL OPERATION	550	7850 CY	0	0	0	0	23550	0	1178	24728
22000.0200014	COMPATIBLE SOIL	550	6675 CY	0	0	0	0	73425	0	3671	77096
22000.0200016	BENTONITE	550	950 TON	0	0	0	0	95000	0	4750	99750
22000.0200018	APPLY SOIL/BENTONITE MIX	550	7850 CY	0	0	0	0	31400	0	1570	32970
22000.0200100	**** LINER SYSTEM ****	550	0	0	0	0	0	0	0	0	0
22000.0200102	60 MIL HDPE DOUBLE LINER	550	131400 SF	0	0	0	0	85410	0	4271	89681
22000.0200104	HDPE GEONET	550	65700 SF	0	0	0	0	29565	0	1478	31043
22000.0200106	VLDPE COVER W/BALAST TUBES & FLOTATION	550	65700 SF	0	0	0	0	137970	0	6899	144869
22000.0200108	ACCESS HATCH IN COVER ALLOW	550	8 EA	0	0	0	0	12000	0	600	12600
22000.0200120	***** LINER ANCHOR *****	550	0	0	0	0	0	0	0	0	0
22000.0200122	EXCAVATION	550	1504 LF	0	0	0	0	5264	0	263	5527
22000.0200124	BACKFILL	550	1504 LF	0	0	0	0	7520	0	376	7896
22000.0200125	BASIN LECHATE SYSTEM	550	2 EA	124	3720	0	5400	0	0	2417	11537
SUBTOTAL SITEWORK				124	3,720	0	5,400	568,210	0	30,829	608,159
	SALES TAX 7.80%						421		0		421
	OH&P / B&I (ON MARKUPS ONLY)									112	112
TOTAL	COST CODE 55002 WBS 322000			124	3,720	0	5,821	568,210	0	30,941	608,692
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
22000.03	CONCRETE										
22000.0300000	**** LINER ANCHOR ****	550	0	0	0	0	0	0	0	0	0
22000.0300002	FINE GRADE FOOTINGS	550	3000 SF	30	684	0	0	0	0	181	865
22000.0300004	FORM LINER ANCHOR	550	12032 SF	1444	36620	0	9024	0	0	12096	57740
22000.0300006	STRIP & OIL	550	12032 SF	301	7633	0	3008	0	0	2820	13461
22000.0300008	CONCRETE LINER ANCHOR	550	112 CY	123	3026	0	6160	0	0	2434	11620

KAISER ENGINEERS HANFORD
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CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
322000.0300010	CURING	550	15040 SF	75	1710	0	226	0	0	513	2449
322000.0300012	REBAR	550	4500 LB	54	1545	0	1260	0	0	743	3548
322000.0300014	FLOAT FINISH	550	1253 SF	25	615	0	0	0	0	163	778
322000.0300016	SST BATTON PLATE 1/4"X 2"	550	1504 LF	496	12579	0	11731	0	0	6442	30752
322000.0300018	NEOP. GASKET 1/4"X 2"	550	1504 LF	135	3424	0	3910	0	0	1944	9278
322000.0300100	**** INFLOW STRUCTURES ****	550	0	0	0	0	0	0	0	0	0
322000.0300102	GRADE & SCREED	550	150 SF	1	25	0	15	0	0	11	51
322000.0300104	FORM SOG	550	80 LF	8	203	0	60	0	0	70	333
322000.0300106	STRIP & OIL	550	80 LF	2	51	0	20	0	0	19	90
322000.0300108	CONCRETE SOG	550	6 CY	6	148	0	330	0	0	127	605
322000.0300110	CURING	550	150 SF	2	46	0	2	0	0	13	61
322000.0300112	REBAR	550	626 LB	9	257	0	175	0	0	114	546
322000.0300114	TROWEL FINISH	550	150 SF	4	98	0	0	0	0	26	124
322000.0300116	SST BATTON PLATE 1/4"X 2"	550	60 LF	20	507	0	468	0	0	258	1233
322000.0300118	NEOP. GASKET 1/4"X 2"	550	60 LF	5	127	0	156	0	0	75	358
322000.0300200	**** OUTFLOW SUMP ****	550	0	0	0	0	0	0	0	0	0
322000.0300202	GRADE & SCREED	550	128 SF	1	25	0	13	0	0	10	48
322000.0300204	FORM SOG	550	64 LF	6	152	0	48	0	0	53	253
322000.0300206	STRIP & OIL	550	64 LF	2	51	0	16	0	0	18	85
322000.0300208	CONCRETE SOG	550	4 CY	4	98	0	220	0	0	84	402
322000.0300210	CURING	550	128 SF	2	46	0	2	0	0	13	61
322000.0300212	REBAR	550	270 LB	4	114	0	76	0	0	50	240
322000.0300214	TROWEL FINISH	550	128 SF	4	98	0	0	0	0	26	124
322000.0300216	SST BATTON PLATE 1/4"X 2" W/ANCHORS	550	48 LF	16	406	0	374	0	0	207	987
322000.0300218	NEOP. GASKET 1/4" X 2"	550	48 LF	4	101	0	125	0	0	60	286
SUBTOTAL CONCRETE				2,783	70,389	0	37,419	0	0	28,570	136,378
	SALES TAX 7.80%						2919		0		2919
	OH&P / B&I (ON MARKUPS ONLY)									773	773
TOTAL	COST CODE 55003 WBS 322000			2,783	70,389	0	40,338	0	0	29,343	140,070

(ESCALATION 13.81% - CONTINGENCY 25.00%)

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
322000.16	ELECTRICAL										
322000.1615002	0.75" PVC COATED GRS 40 MIL	7060	400 LF	36	1097	0	966	0	0	547	2610

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
322000.1624002	4/C #12 CABLE WIRE	7060	2500 LF	55	1676	0	4150	0	0	1544	7370
322000.1661411	SQD HU361RB 30A-600V-3P NEMA 3R SWITCH NF	7060	2 EA	6	183	0	197	0	0	101	481
322000.1668700	220V FRACTIONAL HP MOTOR CONNECTION SAMPLE PUMP	7060	2 EA	2	61	0	18	0	0	21	100
322000.1668701	480V 1.5 HP MOTOR CONNECTION LEACHATE PUMP 1,2	7060	2 EA	3	91	0	18	0	0	29	138
SUBTOTAL ELECTRICAL				102	3,108	0	5,349	0	0	2,242	10,699
	SALES TAX 7.80%						417		0		417
	OH&P / B&I (ON MARKUPS ONLY)									111	111
TOTAL	COST CODE 70616 WBS 322000			102	3,108	0	5,766	0	0	2,353	11,227

(ESCALATION 13.81% - CONTINGENCY 25.00%)

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
322000.1610011	*** PROCESS *** INSTRM/CONTROL	7065	0	0	0	0	0	0	0	0	0
322000.1624003	CONTROL CABLE WIRE	7065	4000 LF	88	2681	0	4360	0	0	1866	8907
322000.1624005	INSTRM CABLE WIRE	7065	4800 LF	106	3230	0	5232	0	0	2242	10704
322000.1681004	0.75" PVC COATED GRS 40 MIL	7065	200 LF	18	548	0	483	0	0	273	1304
322000.1681005	MOV CONN	7065	4 EA	4	122	0	100	0	0	59	281
322000.1681008	FE/FIT FLOW ELEMENT & FLOW IND TRAN CONN	7065	2 EA	2	61	0	50	0	0	29	140
322000.1681010	Y/K PROPORTIONAL SAMPLER CONN	7065	2 EA	2	61	0	50	0	0	29	140
322000.1681012	LEL/LSL LEVEL SENSOR LOW/LEVEL SWITCH LOW LOCAL MOUNT	7065	2 EA	8	244	0	2500	0	0	727	3471
322000.1681014	LEH/LSH LEVEL SENSOR HIGH/LEVEL SWITCH HIGH LOCAL MOUNT	7065	2 EA	8	244	0	2500	0	0	727	3471
322000.1681016	LE/LIT	7065	2 EA	24	731	0	4000	0	0	1254	5985

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	LEVEL ELEMENT & LEVEL IND TRAN INSTALL & CONN										
322000.1681018	IT CURRENT IND INSTALL & CONN	7065	2 EA	24	731	0	1000	0	0	459	2190
322000.1681020	HS HAND SWITCH INSTALL & CONN	7065	2 EA	6	183	0	100	0	0	75	358
322000.1681022	HY SOLENOID VALVE CONN	7065	4 EA	4	122	0	100	0	0	59	281
SUBTOTAL	ELECTRICAL			294	8,958	0	20,475	0	0	7,799	37,232
	SALES TAX 7.80%						1597		0		1597
	OH&P / B&I (ON MARKUPS ONLY)									423	423
TOTAL	COST CODE 70616 WBS 322000			294	8,958	0	22,072	0	0	8,222	39,252

(ESCALATION 13.81% - CONTINGENCY 25.00%)

TOTAL WBS 322000 DIVERSION BASIN 1 & 2	MANHOURS: 3,303	LABOR: 86,175	EQUIP USAGE: 0	MATERIAL: 73,997	SUB-CONTRACT: 568,210	EQUIPMENT: 0	OH&P / B & I: 70,859	TOTAL DOLLARS: 799,241	

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AISER ENGINEERS HANFORD
/ESTINGHOUSE HANFORD COMPANY
'OB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
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CCOUNT UMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
23000	SUMP NO. 2										
23000.02	SITEWORK										
23000.0200004	EXCAVATION	550	230 CY	0	0	0	0	690	0	35	725
23000.0200006	BACKFILL	550	230 CY	0	0	0	0	920	0	46	966
SUBTOTAL SITEWORK				0	0	0	0	1,610	0	81	1,691
TOTAL	COST CODE 55002 WBS 323000			0	0	0	0	1,610	0	81	1,691
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
23000.03	CONCRETE										
23000.0300002	GRADE & SCREED SOG	550	250 SF	1	22	0	12	0	0	9	43
23000.0300004	FORM SOG SUMP	550	60 LF	5	126	0	54	0	0	9	43
23000.0300006	FORM WALLS SUMP	550	960 SF	115	2903	0	864	0	0	48	228
23000.0300008	FORM SUSP SLAB SUMP	550	216 SF	52	1312	0	302	0	0	998	4765
23000.0300010	FORM FOOTINGS BLDG.	550	128 SF	10	252	0	115	0	0	428	2042
23000.0300012	FORM WALLS BLDG.	550	256 SF	31	782	0	230	0	0	97	464
23000.0300014	FORM SOG BLDG.	550	64 LF	5	126	0	58	0	0	268	1280
23000.0300020	STRIP & OIL	550	1684 SF	34	752	0	253	0	0	49	233
23000.0300022	CONCRETE FOOTINGS	550	5 CY	4	96	0	275	0	0	266	1271
23000.0300024	CONCRETE SOG SUMP	550	8 CY	6	143	0	440	0	0	98	469
23000.0300026	CONCRETE SOG WALLS	550	19 CY	21	502	0	1045	0	0	154	737
23000.0300028	CONCRETE SUSP SLAB,SOG BLDG	550	5 CY	4	96	0	275	0	0	410	1957
23000.0300030	CURING	550	1912 SF	10	221	0	29	0	0	98	469
23000.0300032	REBAR	550	3700 LB	37	1054	0	1110	0	0	66	316
23000.0300034	TROWEL FINISH	550	700 SF	4	96	0	0	0	0	573	2737
SUBTOTAL CONCRETE				339	8,483	0	5,062	0	0	3,587	17,132
	SALES TAX 7.80%						395		0		395
	OH&P / B&I (ON MARKUPS ONLY)									105	105

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KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
BY GDC LGH DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL	COST CODE 55003 WBS 323000			339	8,483	0	5,457	0	0	3,692	17,631
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
323000.05	METALS										
323000.0500002	ACCESS LADDER	550	8 LF	8	231	0	480	0	0	188	899
323000.0500004	3' X 3' ACCESS HATCH	550	1 EA	16	462	0	500	0	0	255	1217
323000.0500006	4' X 5' PIT COVER	550	1 EA	16	462	0	800	0	0	334	1596
SUBTOTAL	METALS			40	1,155	0	1,780	0	0	777	3,712
	SALES TAX 7.80%						139		0		139
	OH&P / B&I (ON MARKUPS ONLY)									37	37
TOTAL	COST CODE 55005 WBS 323000			40	1,155	0	1,919	0	0	814	3,888
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
323000.09	FINISHES										
323000.0900006	WATERPROOF SUMP EXTERIOR	550	480 SF	34	789	0	624	0	0	374	1787
323000.0900008	SPC INTERIOR CONCRETE	550	912 SF	64	1485	0	1368	0	0	756	3609
323000.0900010	MISC PAINTING	550	1 LS	40	928	0	600	0	0	405	1933
SUBTOTAL	FINISHES			138	3,202	0	2,592	0	0	1,535	7,329
	SALES TAX 7.80%						202		0		202
	OH&P / B&I (ON MARKUPS ONLY)									54	54

COUNT MBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL	COST CODE 55009 WBS 323000			138	3,202	0	2,794	0	0	1,589	7,585
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
3000.13	SPECIAL CONSTRUCTION										
23000.1300001	PRE-ENGINEERING METAL BLDG.	550	240 SF	0	0	0	0	3600	0	180	3780
SUBTOTAL	SPECIAL CONSTRUCTION			0	0	0	0	3,600	0	180	3,780
TOTAL	COST CODE 55013 WBS 323000			0	0	0	0	3,600	0	180	3,780
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
3000.15	MECHANICAL										
3000.1500002	5 HP PUMP GOULD VIT	700	2 EA	48	1532	0	37000	0	0	10211	48743
3000.1500004	4" MO BUTTERFLY VALVE	700	5 EA	8	255	0	3900	0	0	1101	5256
3000.1500005	4" MO BALL VALVE	700	1 EA	2	64	0	650	0	0	189	903
3000.1500006	4" CHECK VALVE	700	2 EA	2	64	0	480	0	0	144	688
3000.1500008	4" GATE VALVE	700	1 EA	1	32	0	200	0	0	61	293
3000.1500010	4" MAGNETIC FLOW METER	700	1 EA	1	32	0	350	0	0	101	483
3000.1500012	4" FLEX CONNECTOR	700	2 EA	1	32	0	150	0	0	48	230
3000.1500014	4" PIPE AND FITTINGS	700	1 LS	32	1021	0	1250	0	0	602	2873
3000.1500016	LEVEL SENSER	700	1 EA	2	64	0	250	0	0	83	397
3000.1500018	PRESSURE INDICATOR	700	2 EA	3	96	0	200	0	0	78	374
SUBTOTAL	MECHANICAL			100	3,192	0	44,430	0	0	12,618	60,240
	SALES TAX 7.80%						3466		0		3466

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL	COST CODE 55009 WBS 324000			138	3,202	0	2,794	0	0	1,589	7,585
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
324000.13	SPECIAL CONSTRUCTION										
324000.1300001	PRE-ENGINEERING METAL BLDG.	550	240 SF	0	0	0	0	3600	0	180	3780
	SUBTOTAL SPECIAL CONSTRUCTION			0	0	0	0	3,600	0	180	3,780
TOTAL	COST CODE 55013 WBS 324000			0	0	0	0	3,600	0	180	3,780
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
24000.15	MECHANICAL										
24000.1500002	5 HP PUMP GOULD VIT	700	2 EA	48	1532	0	37000	0	0	10211	48743
24000.1500004	4" MO BUTTERFLY VALVE	700	2 EA	3	96	0	1560	0	0	439	2095
24000.1500006	4" CHECK VALVE	700	2 EA	2	64	0	480	0	0	144	688
24000.1500008	4" GATE VALVE	700	1 EA	1	32	0	200	0	0	61	293
24000.1500010	4" MAGNETIC FLOW METER	700	1 EA	1	32	0	350	0	0	101	483
24000.1500012	4" FLEX CONNECTOR	700	2 EA	1	32	0	150	0	0	48	230
24000.1500014	4" PIPE AND FITTINGS	700	1 LS	24	766	0	1000	0	0	468	2234
24000.1500016	LEVEL SENSER	700	1 EA	2	64	0	250	0	0	83	397
24000.1500018	PRESSURE INDICATOR	700	2 EA	3	96	0	200	0	0	78	374
	SUBTOTAL MECHANICAL			85	2,714	0	41,190	0	0	11,633	55,537
	SALES TAX 7.80%						3213		0		3213
	OH&P / B&I (ON MARKUPS ONLY)									851	851

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL	COST CODE 70015 WBS 324000			85	2,714	0	44,403	0	0	12,484	59,601
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
324000.16	ELECTRICAL										
324000.1610011	*** PROCESS *** POWER	7060	0	0	0	0	0	0	0	0	0
324000.1610024	65A 4W FEEDER - 1" GRS WIT 4 #6 THHN CONDUCTORS	7060	10 LF	2	61	0	31	0	0	24	116
324000.1610029	150A 4W FEEDER - 1 1/2" GRS 4 #1/0 THHN CONDUCTORS	7060	10 LF	3	91	0	85	0	0	47	223
324000.1614703	4-2" PVC CONDUITS IN CONCRET ENCASED DUCT BANK COMPLETE TF TO CS-3	7060	200 LF	148	4509	0	2124	0	0	1758	8391
324000.1614801	MANHOLE	7060	1 EA	16	487	0	800	0	0	341	1628
324000.1621215	#2 THHN 1/C COPPER 600V	7060	900 LF	16	487	0	584	0	0	284	1355
324000.1625007	2/C #14 ALPHA SHIELDED SINGLE PAIR	7060	2400 LF	48	1462	0	1992	0	0	915	4369
324000.1638702	480V 7.5KW UNIT HEATER INSTALL & CONNECTION	7060	1 EA	4	122	0	500	0	0	165	787
324000.1639901	OUTLET WIRING - RECEPTACLE & SWITCH, COMPOSITE/GRS	7060	318 SF	10	305	0	404	0	0	188	897
324000.1639902	OUTLET WIRING - LIGHTING EXTERIOR, COMPOSITE/GRS	7060	318 SF	32	975	0	770	0	0	462	2207
324000.1642001	FIRE ALARM CND & WIRE	7060	100 LF	20	609	0	134	0	0	197	940
324000.1642030	MANUAL FIRE ALARM STATION	7060	1 EA	1	30	0	50	0	0	21	101
324000.1642031	HEAT DETECTOR	7060	1 EA	2	61	0	250	0	0	82	393
324000.1642033	FIRE ALARM GONG	7060	1 EA	1	30	0	150	0	0	48	228
324000.1642036	SMOKE DETECTORS	7060	1 EA	1	30	0	115	0	0	38	183
324000.1644010	5/8" STEEL GROUND CABLE	7060	250 LF	10	305	0	113	0	0	111	529
324000.1644040	GROUND PLATE	7060	2 EA	2	61	0	15	0	0	20	96
324000.1644042	CADWELD & PATCH	7060	18 EA	36	1097	0	180	0	0	338	1615
324000.1644043	CONNECT TO BLDG STEEL	7060	2 EA	4	122	0	20	0	0	38	180
324000.1644060	GROUND ROD STEEL 0.75" X 8'	7060	4 EA	4	122	0	37	0	0	42	201
324000.1662000	100 A PNLBD 480Y/277V 18 CKT	7060	1 EA	16	487	0	800	0	0	341	1628
324000.1662002	225 A PNLBD 208Y/120V	7060	1 EA	40	1219	0	1255	0	0	656	3130

E45

CCOUNT UMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
24000.1664106	45 KVA DRY-TYPE TFMR 3 PH 480V-208/120Y	7060	1 EA	17	518	0	1615	0	0	565	2698
24000.1666006	SIZE 1 FUSED COMB STARTER 480V NEMA 12 P3,P3A $ EXH FAN	7060	3 EA	24	731	0	2445	0	0	842	4018
24000.1668700	ROOF VENTALATOR HP MOTOR CONNECTION	7060	1 EA	1	30	0	9	0	0	10	49
24000.1668701	480V 5 HP MOTOR P-3,3A CONNECTION	7060	2 EA	3	91	0	18	0	0	29	138
24000.1668801	480V 5 HP MOTOR & HTR FEEDER, (0.75"GRS W/#12)	7060	150 LF	25	762	0	301	0	0	282	1345
24000.1681004	INSTRM RACK	7060	1 EA	8	247	0	1000	0	0	330	1577
24000.1682002	FE/FIT	7060	1 EA	8	244	0	2000	0	0	595	2839
24000.1682004	LE/LIT	7060	1 EA	8	244	0	2000	0	0	595	2839
24000.1684004	HS 3 POS NEMA 1 ENCLOSURE	7060	2 EA	5	152	0	110	0	0	69	331
24000.1684006	MOV-1,2,3,4 CONNECT	7060	4 EA	4	122	0	100	0	0	59	281
24000.1684008	COND & WIRE ALLOWANCE INSTRM	7060	400 LF	32	975	0	680	0	0	439	2094 E46
SUBTOTAL ELECTRICAL				551	16,788	0	20,687	0	0	9,931	47,406
	SALES TAX 7.80%						1614		0		1614
	OH&P / B&I (ON MARKUPS ONLY)									428	428
TOTAL	COST CODE 70616 WBS 324000			551	16,788	0	22,301	0	0	10,359	49,447

(ESCALATION 13.81% - CONTINGENCY 25.00%)

		MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL WBS 324000 SUMP NO. 3		1,153	32,342	0	76,873	5,210	0	29,198	143,623

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
325000	VALVE PITS										
325000.03	CONCRETE										
325000.0300002	VALVE PIT (LARGE) ALLOW	550	3 EA	0	0	0	0	75000	0	3750	78750
325000.0300004	VALVE PIT (SMALL) ALLOW	550	4 EA	0	0	0	0	52000	0	2600	54600
	SUBTOTAL CONCRETE			0	0	0	0	127,000	0	6,350	133,350
TOTAL	COST CODE 55003 WBS 325000			0	0	0	0	127,000	0	6,350	133,350
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
325000.15	MECHANICAL										
325000.1500002	6" BUTTERFLY VALVE	700	6 EA	6	192	0	3000	0	0	846	4038
325000.1500004	4" BUTTERFLY VALVE	700	8 EA	6	192	0	640	0	0	220	1052
325000.1500005	4" MO BUTTERFLY VALVE	700	6 EA	9	287	0	4680	0	0	1316	6283
325000.1500006	4" CHECK VALVE	700	2 EA	2	64	0	480	0	0	144	688
325000.1500008	6" PIPE AND FITTINGS (ALLOW)	700	1 LS	8	255	0	250	0	0	134	639
325000.1500010	4" PIPE AND FITTINGS (ALLOW)	700	1 LS	96	3064	0	4500	0	0	2004	9568
325000.1500012	PROPORTIONAL SAMPLER (ALLOW)	700	1 LS	16	511	0	3500	0	0	1063	5074
	SUBTOTAL MECHANICAL			143	4,565	0	17,050	0	0	5,727	27,342
	SALES TAX 7.80%						1330		0		1330
	OH&P / B&I (ON MARKUPS ONLY)									352	352
TOTAL	COST CODE 70015 WBS 325000			143	4,565	0	18,380	0	0	6,079	29,024
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										

E47

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
325000.16	ELECTRICAL										
325000.1610011	*** PROCESS *** INSTRM/CONTROL	7065	0	0	0	0	0	0	0	0	0
325000.1614721	2-4" PVC CONDUITS IN CONCRET ENCASED DUCT BANK COMPLETE	7065	880 LF	581	17702	0	10586	0	0	7496	35784
325000.1614801	MANHOLE	7065	2 EA	32	975	0	1600	0	0	682	3257
325000.1624003	CONTROL CABLE WIRE	7065	4500 LF	99	3016	0	4905	0	0	2099	10020
325000.1681005	MOV CONN	7065	11 EA	11	335	0	275	0	0	162	772
SUBTOTAL	ELECTRICAL			723	22,028	0	17,366	0	0	10,439	49,833
	SALES TAX 7.80%						1355		0		1355
	OH&P / B&I (ON MARKUPS ONLY)									359	359
TOTAL	COST CODE 70616 WBS 325000			723	22,028	0	18,721	0	0	10,798	51,547

(ESCALATION 13.81% - CONTINGENCY 25.00%)

	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL WBS 325000 VALVE PITS	866	26,593	0	37,100	127,000	0	23,227	213,921

E48

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
326000	UNDERGROUND PIPING										
326000.02	SITEWORK										
326000.0200002	EXCAVATION AND BACKFILL FOR UNDER GROUND PIPING	700	1800 CY	0	0	0	0	10350	0	518	10868
326000.0200004	6" SCH 80 PVC PIPE	700	1840 LF	202	6448	0	5796	0	0	3245	15489
326000.0200006	4" SCH 80 PVC PIPE	700	3000 LF	240	7661	0	4950	0	0	3342	15953
326000.0200008	6" SCH 80 PVC FITTINGS	700	12 EA	4	128	0	168	0	0	78	374
326000.0200010	4" SCH 80 PVC FITTINGS	700	30 EA	8	255	0	150	0	0	107	512
326000.0200012	6" SCH 80 PVC COUPLINGS	700	92 EA	0	0	0	1012	0	0	268	1280
326000.0200014	4" SCH 80 PVC COUPLINGS	700	150 EA	0	0	0	825	0	0	219	1044
326000.0200016	MISC. WORK, TERRA TAPE,FLUSH AND TEST	700	4840 LF	48	1532	0	726	0	0	598	2856
SUBTOTAL	SITEWORK			502	16,024	0	13,627	10,350	0	8,375	48,376
	SALES TAX 7.80%						1063		0		1063
	OH&P / B&I (ON MARKUPS ONLY)									282	282
TOTAL	COST CODE 70002 WBS 326000			502	16,024	0	14,690	10,350	0	8,657	49,721
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
TOTAL WBS 326000 UNDERGROUND PIPING				502	16,024	0	14,690	10,350	0	8,657	49,721

E49

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
BY GDC LGH DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327101	FACILITY - PROCESS TREATMENT AREA										
327101.02	SITEWORK										
327101.0234502	EXCAVATION	501	270 CY	0	0	0	0	675	0	34	709
327101.0234504	BACKFILL	501	270 CY	0	0	0	0	540	0	27	567
	SUBTOTAL SITEWORK			0	0	0	0	1,215	0	61	1,276
TOTAL	COST CODE 50102 WBS 327101 (ESCALATION 13.81% - CONTINGENCY 25.00%)			0	0	0	0	1,215	0	61	1,276
327101.03	CONCRETE										
327101.0345100	(EVAPORATOR PAD 40X100) GRADE & SCREED SOG	501	5100 SF	31	741	0	255	0	0	264	1260
327101.0345102	(EVAPORATOR PAD 40X100) FORM SOG	501	354 LF	28	707	0	319	0	0	272	1298
327101.0345104	(EVAPORATOR PAD 40X100) STRIP & OIL	501	354 SF	7	155	0	53	0	0	55	263
327101.0345106	(EVAPORATOR PAD 40X100) CONCRETE SOG	501	200 CY	160	3826	0	10400	0	0	3770	17996
327101.0345108	(EVAPORATOR PAD 40X100) CURING	501	5100 SF	25	553	0	76	0	0	167	796
327101.0345110	(EVAPORATOR PAD 40X100) REBAR SLAB	501	20000 LBS	160	4558	0	6000	0	0	2798	13356
327101.0345112	(EVAPORATOR PAD 40X100) TROWEL FINISH	501	5100 SF	31	741	0	0	0	0	196	937
327101.0345602	GRADE & SCREED SOG	501	4000 SF	24	574	0	200	0	0	205	979
327101.0345604	FORM SOG	501	290 LF	23	581	0	261	0	0	223	1065
327101.0345606	FORM FOOTINGS	501	580 SF	46	1161	0	522	0	0	446	2129
327101.0345608	FORM WALLS	501	1160 SF	139	3508	0	1044	0	0	1206	5758
327101.0345610	FORM CURBS	501	380 SF	76	1918	0	342	0	0	599	2859
327101.0345612	KEY JOINTS	501	220 LF	11	263	0	110	0	0	99	472
327101.0345614	STRIP & OIL	501	2100 SF	42	929	0	315	0	0	330	1574
327101.0345616	CONCRETE FOOTINGS	501	18 CY	14	335	0	936	0	0	337	1608
327101.0345618	CONCRETE SOG & RAMPS	501	147 CY	118	2821	0	7644	0	0	2773	13238

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327101.0345620	CONCRETE WALLS & COLUMNS	501	20 CY	22	526	0	1040	0	0	415	1981
327101.0345622	CONCRETE CURBS	501	5 CY	5	120	0	260	0	0	101	481
327101.0345624	CURING	501	5680 SF	28	619	0	85	0	0	187	891
327101.0345626	REBAR SLAB	501	10000 LBS	80	2279	0	3000	0	0	1399	6678
327101.0345628	REBAR WALLS	501	4000 LBS	40	1140	0	1200	0	0	620	2960
327101.0345630	TROWEL FINISH	501	4386 SF	26	622	0	0	0	0	165	787
327101.0345632	INTERIOR EQUIPMENT PADS FORM PADS	501	480 LF	38	959	0	432	0	0	369	1760
327101.0345634	CONCRETE SOG	501	188 CY	150	3586	0	9776	0	0	3541	16903
327101.0345636	REBAR	501	11280 LBS	90	2564	0	3384	0	0	1576	7524
327101.0345638	TROWEL FINISH	501	1680 SF	10	239	0	0	0	0	63	302
327101.0345642	FORM TRENCH WALLS 2'WIDE X 3'DEEP	501	1300 SF	156	3937	0	1170	0	0	1353	6460
327101.0345644	TRENCH WALLS STRIP & OIL	501	1300 SF	26	575	0	195	0	0	204	974
327101.0345646	TRENCH WALLS CONCRETE WALLS	501	25 CY	27	646	0	1300	0	0	516	2462
327101.0345648	TRENCH WALLS CURING	501	1300 SF	6	133	0	19	0	0	40	192
327101.0345650	TRENCH WALLS REBAR	501	2500 LBS	25	712	0	750	0	0	387	1849
327101.0345652	TRENCH WALLS TROWEL FINISH	501	632 SF	4	96	0	0	0	0	25	121
327101.0345660	DIKED AREA (TWO TANKS) FORM SOG	501	94 LF	8	202	0	85	0	0	76	363
327101.0345662	DIKED AREA (TWO TANKS) FORM WALLS	501	656 SF	79	1994	0	590	0	0	685	3269
327101.0345664	DIKED AREA (TWO TANKS) STRIP & OIL	501	750 SF	15	332	0	112	0	0	118	562
327101.0345666	DIKED AREA (TWO TANKS) CONCRETE SOG	501	20 CY	16	383	0	1040	0	0	377	1800
327101.0345668	DIKED AREA (TWO TANKS) CONCRETE WALLS	501	15 CY	16	383	0	780	0	0	308	1471
327101.0345670	DIKED AREA (TWO TANKS) CURING	501	750 SF	4	88	0	11	0	0	26	125
327101.0345672	DIKED AREA (TWO TANKS) REBAR	501	2800 LBS	28	798	0	840	0	0	434	2072
327101.0345674	DIKED AREA (TWO TANKS) TROWEL FINISH	501	276 SF	2	48	0	0	0	0	13	61
327101.0345680	(CATCH TANK BASIN) 10X20X6 FORM SLAB	501	44 LF	4	101	0	40	0	0	37	178
327101.0345682	(CATCH TANK BASIN) 10X20X6 FORM WALLS	501	528 SF	63	1590	0	475	0	0	547	2612
327101.0345684	(CATCH TANK BASIN) 10X20X6 STRIP & OIL	501	572 SF	11	243	0	86	0	0	87	416
327101.0345686	(CATCH TANK BASIN) 10X20X6	501	6 CY	5	120	0	312	0	0	114	546

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	CONCRETE SLAB										
327101.0345688	(CATCH TANK BASIN) 10X20X6	501	10 CY	11	263	0	520	0	0	207	990
	CONCRETE WALLS										
327101.0345690	(CATCH TANK BASIN) 10X20X6	501	650 SF	3	66	0	10	0	0	20	96
	CURING										
327101.0345692	(CATCH TANK BASIN) 10X20X6	501	1600 LBS	16	456	0	480	0	0	248	1184
	REBAR										
SUBTOTAL	CONCRETE			1,949	49,191	0	56,469	0	0	27,998	133,658
	SALES TAX 7.80%						4405		0		4405
	OH&P / B&I (ON MARKUPS ONLY)									1167	1167
TOTAL	COST CODE 50103 WBS 327101			1,949	49,191	0	60,874	0	0	29,165	139,230
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327101.04	MASONRY										
327101.0456702	12" CONCRETE BLOCK WALL	501	1600 SF	0	0	0	0	13600	0	680	14280
SUBTOTAL	MASONRY			0	0	0	0	13,600	0	680	14,280
TOTAL	COST CODE 50104 WBS 327101			0	0	0	0	13,600	0	680	14,280
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327101.05	METALS										
327101.0567802	STEEL GRATING	501	700 SF	28	798	0	8400	0	0	2437	11635
327101.0567804	STEEL GRATING SUMP	501	120 SF	5	142	0	1440	0	0	419	2001

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	SUBTOTAL METALS			33	940	0	9,840	0	0	2,856	13,636
	SALES TAX 7.80%						768		0		768
	OH&P / B&I (ON MARKUPS ONLY)									203	203
	TOTAL COST CODE 50105 WBS 327101			33	940	0	10,608	0	0	3,059	14,607
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327101.07	MOISTURE AND THERMAL CONTROL										
327101.0765402	DAMPPROOFING	501	500 SF	10	252	0	120	0	0	99	471
327101.0765404	RIGID INSULATION BOARD 2"	501	1000 SF	10	252	0	200	0	0	120	572
327101.0765408	SEALANTS	501	1 JOB	16	404	0	300	0	0	187	891
	SUBTOTAL MOISTURE AND THERMAL CONTROL			36	908	0	620	0	0	406	1,934
	SALES TAX 7.80%						48		0		48
	OH&P / B&I (ON MARKUPS ONLY)									13	13
	TOTAL COST CODE 50107 WBS 327101			36	908	0	668	0	0	419	1,995
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327101.08	DOORS, WINDOWS AND GLASS										
327101.0876502	6/0 HM DOOR & FRAME EXT	501	1 EA	6	151	0	1100	0	0	332	1583
327101.0876504	3/0 HM DOOR & FRAME EXT	501	3 EA	12	303	0	1950	0	0	597	2850
327101.0876506	14X16 ROLL UP DOOR	501	1 EA	55	1388	0	5600	0	0	1852	8840

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
SUBTOTAL	DOORS, WINDOWS AND GLASS			73	1,842	0	8,650	0	0	2,781	13,273
	SALES TAX 7.80%						675		0		675
	OH&P / B&I (ON MARKUPS ONLY)									179	179
TOTAL	COST CODE 50108 WBS 327101			73	1,842	0	9,325	0	0	2,960	14,126
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327101.09	FINISHES										
327101.0987602	PROTECTIVE COATING ON FLOORS AND UP 4' ON WALLS.	501	9500 SF	0	0	0	0	21375	0	1069	22444
327101.0987604	PAINT DOORS	501	5 EA	0	0	0	0	175	0	9	184
SUBTOTAL	FINISHES			0	0	0	0	21,550	0	1,078	22,628
TOTAL	COST CODE 50109 WBS 327101			0	0	0	0	21,550	0	1,078	22,628
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327101.13	SPECIAL CONSTRUCTION										
327101.1345602	STEEL BUILDING 102X43X20	501	4386 SF	0	0	0	0	98685	0	4934	103619
SUBTOTAL	SPECIAL CONSTRUCTION			0	0	0	0	98,685	0	4,934	103,619

CCOUNT UMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL	COST CODE 50113 WBS 327101			0	0	0	0	98,685	0	4,934	103,619
	(ESCALATION 13.81% - CONTINGENCY 20.00%)										
TOTAL WBS 327101 FACILITY - PROCESS TREATMENT AREA				2,091	52,881	0	81,474	135,050	0	42,356	311,761

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KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

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300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
BY GDC LGH DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327102	PROCESS TREATMENT MECH.										
327102.11	EQUIPMENT										
327102.1100000	**************************** PROCESS EQUIPMENT ****************************	700	0	0	0	0	0	0	0	0	0
327102.1100002	50,000 GAL. SURGE TANK SITE ERECTED W/INSULLATION & HEAT TRACE	700	1 EA	0	0	0	0	140000	0	7000	147000
327102.1100004	TRANSFER PUMPS 5 HP	700	10 EA	240	7661	0	38000	0	0	12100	57761
327102.1100006	MULTI-MEDIA FILTERS SKID MOUNTED	700	1 SK	32	1021	0	100000	0	0	26771	127792
327102.1100008	GRANULAR-ACTIVATED CARBON FILTERS SKID MOUNTED	700	1 SK	56	1788	0	200000	0	0	53474	255262
327102.1100010	RO SURGE TANK 500 GAL	700	1 EA	16	511	0	800	0	0	347	1658
327102.1100012	REVERSE OSMOSIS UNIT SKID MOUNTED	700	1 SK	64	2043	0	350000	0	0	93291	445334
327102.1100014	MIXED BED IX COLUMNS SKID MOUNTED	700	1 SK	56	1788	0	150000	0	0	40224	192012
327102.1100016	IN-LINE MIXER	700	1 EA	8	255	0	3000	0	0	863	4118
327102.1100018	EVAP. SURGE TANK 15000 GAL INSULATED & HEAT TRACED	700	1 EA	8	255	0	25000	0	0	6693	31948
327102.1100020	MVR EVAPORATOR/CRYSTALLIZER SKID MOUNTED	700	1 EA	240	7661	0	1500000	0	0	399530	1907191
327102.1100022	ACID STORAGE TANK 2000 GAL FRP INSULATED & HEAT TRACED	700	1 EA	24	766	0	8000	0	0	2323	11089
327102.1100024	CAUSTIC STORAGE TANK 2000 GAL CS INSULATED & HEAT TRACED	700	1 EA	24	766	0	12000	0	0	3383	16149
327102.1100026	REGENERANT STORGAE TANK 15000 GAL FRP	700	2 EA	96	3064	0	30000	0	0	8762	41826
327102.1100028	ACID DAY TANK 500 GAL FRP	700	1 EA	16	511	0	800	0	0	347	1658
327102.1100029	CAUSTIC DAY TANK 500 GAL FRP	700	1 EA	16	511	0	800	0	0	347	1658
327102.1100032	ELEC STEAM BOILER 1500 LBS/HR	700	1 EA	56	1788	0	15000	0	0	4449	21237
327102.1100034	AIR COMPRESSOR 40SCFM W/660 GAL RECEIVER TANK	700	1 EA	56	1788	0	5000	0	0	1799	8587
327102.1100038	CHEM METTERING PUMP	700	2 EA	32	1021	0	6400	0	0	1967	9388
	SUBTOTAL EQUIPMENT			1,040	33,198	0	2,444,800	140,000	0	663,670	3,281,668
	SALES TAX 7.80%						190694		0		190694
	OH&P / B&I (ON MARKUPS ONLY)									50534	50534

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL	COST CODE 70011 WBS 327102 (ESCALATION 13.81% - CONTINGENCY 20.00%)			1,040	33,198	0	2,635,494	140,000	0	714,204	3,522,89
327102.15	MECHANICAL										
327102.1500000	****************************** PROCESS STREAM ******* ALLOW **********	700	0	0	0	0	0	0	0	0	0
327102.1500002	4" PIPE PVC	700	600 LF	66	2107	0	990	0	0	821	3918
327102.1500004	4" FITTINGS PVC	700	90 EA	49	1564	0	450	0	0	534	2548
327102.1500005	4" BALL VALVE PVC	700	32 EA	19	606	0	6720	0	0	1941	9267
327102.1500006	4" MOV BALL VALVE PVC	700	8 EA	6	192	0	5200	0	0	1429	6821
327102.1500008	4" INSULATION W/JACKET	700	100 LF	25	798	0	500	0	0	344	1642
327102.1500010	4" HANGER IN TRENCH	700	100 EA	25	798	0	500	0	0	344	1642
327102.1500012	4" SUPPORT	700	16 EA	40	1277	0	320	0	0	423	2020
327102.1500020	2" PIPE PVC	700	100 LF	9	287	0	55	0	0	91	433
327102.1500022	2" FITTINGS PVC	700	32 EA	11	351	0	112	0	0	123	586
327102.1500024	2" BALL VALVE PVC	700	8 EA	4	128	0	200	0	0	87	415
327102.1500026	2" INSULATION	700	20 LF	3	96	0	100	0	0	52	248
327102.1500028	2" SUPPORTS	700	8 EA	12	383	0	120	0	0	133	636
327102.1500030	FLUSH & TEST	700	1 LS	16	511	0	0	0	0	135	646
327102.1500100	****************************** RO CONC & IX REGEN ****** ALLOW **********	700	0	0	0	0	0	0	0	0	0
327102.1500120	2" PIPE PVC	700	200 LF	18	575	0	110	0	0	182	867
327102.1500122	2" FITTINGS PVC	700	48 EA	16	511	0	168	0	0	180	859
327102.1500124	2" BALL VALVE PVC	700	8 EA	4	128	0	200	0	0	87	415
327102.1500126	2" INSULATION	700	80 LF	12	383	0	400	0	0	207	990
327102.1500128	2" SUPPORTS	700	8 EA	12	383	0	120	0	0	133	636
327102.1500129	2" HANGERS IN TRENCH	700	20 EA	5	160	0	100	0	0	69	329
327102.1500130	FLUSH & TEST	700	1 LS	16	511	0	0	0	0	135	646
327102.1500200	****************************** STEAM & COND PIPING ******* ALLOW **********	700	0	0	0	0	0	0	0	0	0
327102.1500202	2" PIPE CS SCRD	700	80 LF	11	351	0	160	0	0	135	646
327102.1500204	2" FITTINGS CS SCRD	700	20 EA	12	383	0	100	0	0	128	611
327102.1500206	2" VALVES CS SCRD	700	4 EA	3	96	0	320	0	0	110	526
327102.1500208	2" MOV CS SCRD	700	1 EA	1	32	0	350	0	0	101	483

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327102.1500210	2" PI	700	2 EA	1	32	0	150	0	0	48	230
327102.1500212	2" INSULATION	700	80 LF	12	383	0	400	0	0	207	990
327102.1500214	2" SUPPORTS	700	8 EA	12	383	0	120	0	0	133	636
327102.1500216	FLUSH & TEST	700	1 LS	16	511	0	0	0	0	135	646
327102.1500300	****************************	700	0	0	0	0	0	0	0	0	0
	ACID PIPING										
	******* ALLOW **********										
327102.1500302	1" PIPE KYNAR	700	100 LF	14	447	0	1730	0	0	577	2754
327102.1500304	1" FITTINGS KYNAR	700	20 EA	50	1596	0	1000	0	0	688	3284
327102.1500306	1" BALL VALVE KYNAR	700	3 EA	9	287	0	330	0	0	164	781
327102.1500308	1" MOV BALL VALVE KYNAR	700	1 EA	4	128	0	350	0	0	127	605
327102.1500310	1" SUPPORTS	700	2 EA	3	96	0	30	0	0	33	159
327102.1500312	1" HANGERS IN TRENCH	700	10 EA	3	96	0	50	0	0	39	185
327102.1500314	1" INSULATION	700	40 LF	8	255	0	160	0	0	110	525
327102.1500316	FLUSH & TEST	700	1 LS	16	511	0	0	0	0	135	646
327102.1500400	****************************	700	0	0	0	0	0	0	0	0	0
	CAUSTIC PIPING										
	******* ALLOW **********										
327102.1500402	1" PIPE CS	700	100 LF	14	447	0	100	0	0	145	692
327102.1500404	1" FITTINGS CS SCRD	700	20 EA	10	319	0	60	0	0	100	479
327102.1500406	1" VALVES CS SCRD	700	3 EA	2	64	0	150	0	0	57	271
327102.1500408	1" MOV CS SCRD	700	1 EA	1	32	0	250	0	0	75	357
327102.1500410	1" SUPPORTS	700	2 EA	3	96	0	30	0	0	33	159
327102.1500412	1" HANGERS IN TRENCH	700	10 EA	3	96	0	50	0	0	39	185
327102.1500414	1" INSULATION	700	100 LF	20	638	0	400	0	0	275	1313
327102.1500416	FLUSH & TEST	700	1 LS	16	511	0	0	0	0	135	646
327102.1500500	****************************	700	0	0	0	0	0	0	0	0	0
	AIR PIPING										
	******* ALLOW **********										
327102.1500502	1" PIPE CS	700	400 LF	56	1788	0	400	0	0	580	2768
327102.1500504	1" FITTINGS CS SCRD	700	100 EA	50	1596	0	300	0	0	502	2398
327102.1500506	1" VALVES CS SCRD	700	10 EA	6	192	0	500	0	0	183	875
327102.1500510	1" HANGERS	700	40 EA	60	1915	0	600	0	0	666	3181
327102.1500512	PI	700	4 EA	1	32	0	300	0	0	88	420
327102.1500514	TEST	700	1 LS	16	511	0	0	0	0	135	646
327102.1500600	****************************	700	0	0	0	0	0	0	0	0	0
	PROCESS DRAINS										
	******* ALLOW **********										
327102.1500602	CATCH TANK 1,000 GAL.	700	1 EA	16	511	0	1200	0	0	453	2164
327102.1500604	4" PIPE	700	160 LF	18	575	0	264	0	0	222	1061
327102.1500606	2" PIPE	700	100 LF	9	287	0	55	0	0	91	433
327102.1500608	4" FITTINGS	700	48 EA	26	830	0	240	0	0	284	1354
327102.1500610	2" FITTINGS	700	28 EA	9	287	0	98	0	0	102	487
327102.1500612	4" HANGERS IN TRENCH	700	20 EA	8	255	0	120	0	0	99	474
327102.1500614	2" HANGERS IN TRENCH	700	18 EA	5	160	0	90	0	0	66	316
327102.1500616	FLUSH & TEST	700	1 EA	16	511	0	0	0	0	135	646

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
SUBTOTAL	MECHANICAL			908	28,989	0	26,822	0	0	14,785	70,596
	SALES TAX 7.80%						2092		0		2092
	OH&P / B&I (ON MARKUPS ONLY)									554	554
TOTAL	COST CODE 70015 WBS 327102 (ESCALATION 13.81% - CONTINGENCY 35.00%)			908	28,989	0	28,914	0	0	15,339	73,243
TOTAL WBS 327102 PROCESS TREATMENT MECH.				1,948	62,187	0	2,664,409	140,000	0	729,543	3,596,139

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327103	TREATMENT FACILITY ELECTRICAL										
327103.16	ELECTRICAL										
327103.1610002	30A 3W FEEDER - 1/2" GRS WIT 3 #10 THHN CONDUCTORS 20 KW UNIT HTR FEEDER	501	700 LF	71	2163	0	1056	0	0	853	4072
327103.1631002	400W HPS LIGHT FIXTURE W/QUARTZ ASSUME 1 PER 500 SF	501	8 EA	18	548	0	4000	0	0	1205	5753
327103.1631004	COND & WIRE	501	4000 SF	48	1462	0	760	0	0	589	2811
327103.1632022	EXIT W/EMERGENCY PAK	501	3 EA	3	91	0	405	0	0	131	627
327103.1632024	EMERGENCY 2 HEAD W/BATT PAK WALL MT	501	4 EA	12	366	0	1408	0	0	470	2244
327103.1632025	WALL FIXTURE 55W LPS	501	3 EA	9	274	0	1260	0	0	407	1941
327103.1642030	MANUAL FIRE ALARM STATION	501	3 EA	3	91	0	150	0	0	64	305
327103.1642033	FIRE ALARM GONG	501	2 EA	2	61	0	300	0	0	96	457
327103.1642036	SMOKE DETECTORS	501	4 EA	4	122	0	460	0	0	154	736
327103.1642037	HEAT DETECTORS	501	4 EA	8	244	0	860	0	0	293	1397
327103.1642144	CONDUIT & WIRE ALLOWANCE	501	1 JOB	40	1219	0	1000	0	0	588	2807
327103.1661201	SQD H361 30A-600V-3P NEMA 1 SWITCH 20 KW HEATER SW.	501	4 EA	12	366	0	425	0	0	210	1001
327103.1661202	SQD H361 30A-600V-3P NEMA 1 SWITCH ROLL-UP DOOR HDSW.	501	1 EA	3	91	0	106	0	0	52	249
327103.1661211	SQD H361RB 30A-600V-3P NEMA 3R SWITCH EF-1 SW	501	1 EA	3	91	0	190	0	0	74	355
327103.1668002	480V HP MOTOR CONNECTION ROLL-UP DOOR	501	1 EA	4	122	0	20	0	0	38	180
327103.1668004	480V 1.5 HP MOTOR EF-1 CONNECTION ON ROOF	501	1 EA	1	30	0	9	0	0	10	49
327103.1668015	*** HEAT *** ASSUME 84000 CF OF AIR TO BE HEATED ASSUME 62 BTU LOSS	501	0	0	0	0	0	0	0	0	0
327103.1668016	UNIT HTR 20 KW 480V W/ REMOTE STAT INSTALL	501	4 EA	64	1950	0	4000	0	0	1577	7527
327103.1668017	480V 1-1/2 HP MOTOR EF-1 FEEDER, (0.75"GRS W/#12)	501	150 LF	25	1950	0	299	0	0	596	2845
	SUBTOTAL ELECTRICAL			330	11,241	0	16,708	0	0	7,407	35,356

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ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	SALES TAX 7.80%						1303		0		1303
	OH&P / B&I (ON MARKUPS ONLY)									345	345
TOTAL	COST CODE 50116 WBS 327103			330	11,241	0	18,011	0	0	7,752	37,005
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327103.1610024	65A 4W FEEDER - 1" GRS WIT 4 #6 THHN CONDUCTORS	7060	150 LF	25	762	0	485	0	0	330	1577
327103.1610036	335A 4W FEEDER - 3" GRS 4 #400 MCM THHN CONDUCTORS STEAM GENERATOR 450 KW	7060	150 LF	70	2133	0	3834	0	0	1581	7548
327103.1610037	335A 4W FEEDER - 3" GRS 4 #400 MCM THHN CONDUCTORS STEAM GENERATOR 450 KW	7060	150 LF	70	2133	0	3834	0	0	1581	7548
327103.1610060	1000A 4W FEEDER - 3-3" GRS 4#400 MCM THHN CONDUCTORS EA EVAPORATOR 645 KW	7060	200 LF	233	7099	0	15013	0	0	5860	27972
327103.1661407	SQD HU367 800A-600V-3P NEMA 1 SWITCH NF HDSW FOR 450 KW STEAM GEN.	7060	1 EA	18	548	0	2451	0	0	795	3794
327103.1661408	SQD HU368R 1200A-600V-3P NEMA 3R SWITCH NF	7060	1 EA	22	670	0	3296	0	0	1051	5017
327103.1661409	SQD HU367 800A-600V-3P NEMA 1 SWITCH NF HDSW FOR 450 KW STEAM GEN.	7060	1 EA	18	548	0	2451	0	0	795	3794
327103.1661431	SQD HU361AWK 30A-600V-3P NEMA 3R,12 SWITCH NF	7060	5 EA	15	457	0	650	0	0	293	1400
327103.1661432	SQD HU362AWK 60A-600V-3P NEMA 12 SWITCH NF NEUTRALIZER HDSW	7060	1 EA	4	122	0	167	0	0	77	366
327103.1662006	60A 240V/120V POWER PNL HEAT TRACE	7060	1 EA	10	305	0	450	0	0	200	955
327103.1664014	10 KVA TFMR.1 PH DRY-TYPE 240/480V-120/240V	7060	1 EA	9	274	0	586	0	0	228	1088
327103.1668000	PROCESS AREA HEAT TRACE CONTROLLER ALLOWANCE	7060	1 EA	50	1523	0	2000	0	0	934	4457
327103.1668701	480V 10 HP MOTOR CONNECTION PROCESS PUMPS/METERING PUMPS	7060	4 EA	6	183	0	35	0	0	58	276

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327103.1668702	480V 15 HP MOTOR CONNECTION AIR COMPRESSOR	7060	1 EA	2	61	0	13	0	0	20	9
327103.1668704	480V EQUIPMENT CONNECTION NEUTRALIZER	7060	1 EA	2	61	0	13	0	0	20	9
327103.1668711	480V 450 KW STEAM GEN CONNECTION	7060	1 EA	16	487	0	624	0	0	294	140
327103.1668714	480V 645 KW EVAPORATOR CONNECTION	7060	1 EA	28	853	0	1241	0	0	555	264
327103.1668801	480V 10 HP MOTOR FEEDER, (0.75"GRS W/#12) PROCESS PUMPS/METERING PUMPS	7060	400 LF	66	2011	0	797	0	0	744	355
327103.1668802	480V 15 HP MOTOR FEEDER, (0.75"GRS W/#10) AIR COMPRESSOR	7060	150 LF	25	762	0	325	0	0	288	137
327103.1668804	480V EQUIPMENT FEEDER, (1.25"GRS W/# 6) NEUTRALIZER	7060	150 LF	34	1036	0	608	0	0	436	208
327103.1683002	HEAT TRACE ALLOWANCE	7060	1 JOB	40	1219	0	1500	0	0	721	344
327103.1683004	EVAPORATOR ASSEMBLY ALLOWANCE	7060	1 JOB	96	2926	0	1500	0	0	1173	559
SUBTOTAL	ELECTRICAL			859	26,173	0	41,873	0	0	18,034	86,08
	SALES TAX 7.80%						3266		0		326
	OH&P / B&I (ON MARKUPS ONLY)									866	86
TOTAL	COST CODE 70616 WBS 327103			859	26,173	0	45,139	0	0	18,900	90,21
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327103.1610011	*** PROCESS *** INSTRM/CONTROL	7065	0	0	0	0	0	0	0	0	0
327103.1611002	0.75" GRS CONDUIT	7065	8100 LF	1306	39792	0	28290	0	0	18042	86124
327103.1624002	CONTROL CABLE WIRE	7065	10800 LF	238	7251	0	17928	0	0	6672	31851
327103.1624005	INSTRM CABLE WIRE	7065	4800 LF	106	3230	0	5232	0	0	2242	10704
327103.1681005	MOV	7065	27 EA	27	823	0	675	0	0	397	1895

KAISER ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. L-045H/ER0184

** KAISER ENGINEERS INTERACTIVE ESTIMATING **
300 AREA TREATED EFF. DIPOSAL FACILITY
CONCEPTUAL ESTIMATE
KEHR08 - ESTIMATE DETAIL BY WBS / COST CODE

DATE 05/04/90 07:26
BY GDC LGH DKH

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	CONN										
327103.1681008	FE/FIT FLOW ELEMENT & FLOW IND TRAN CONN	7065	3 EA	3	91	0	75	0	0	44	210
327103.1681016	LE/LIT LEVEL ELEMENT & LEVEL IND TRAN INSTALL & CONN	7065	4 EA	48	1462	0	8000	0	0	2507	11969
327103.1681020	HS HAND SWITCH INSTALL & CONN	7065	1 EA	3	91	0	50	0	0	37	178
327103.1681022	PDIT PRESSURE IND TRANSMIT CONN	7065	4 EA	8	244	0	100	0	0	91	435
327103.1681028	AI/AE ANALYSIS IND CONN	7065	1 EA	2	61	0	25	0	0	23	109
327103.1681030	CT/CE CONDUCTIVITY IND CONN	7065	1 EA	2	61	0	25	0	0	23	109
327103.1681036	TIT/TE TEMP IND TRANSMIT CONN	7065	1 EA	8	244	0	500	0	0	197	941
327103.1681038	RO SYSTEM CONN	7065	1 EA	16	488	0	50	0	0	143	681
327103.1681040	STEAM GEN CONN	7065	1 EA	16	488	0	50	0	0	143	681
327103.1681042	EVAPORATOR CONN	7065	1 EA	16	488	0	50	0	0	143	681
327103.1681060	ATP	7065	1 EA	120	3660	0	0	0	0	970	4630
SUBTOTAL ELECTRICAL				1,919	58,474	0	61,050	0	0	31,674	151,198
	SALES TAX 7.80%						4762		0		4762
	OH&P / B&I (ON MARKUPS ONLY)									1262	1262
TOTAL	COST CODE 70616 WBS 327103			1,919	58,474	0	65,812	0	0	32,936	157,222

(ESCALATION 13.81% - CONTINGENCY 25.00%)

E63

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	TOTAL WBS 327103 TREATMENT FACILITY ELECTRICAL			3,108	95,888	0	128,962	0	0	59,588	284,438

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327201	FACILITY - OPERATIONS AREA										
327201.02	SITEWORK										
327201.0234502	EXCAVATION	501	80 CY	0	0	0	0	200	0	10	210
327201.0234504	BACKFILL	501	80 CY	0	0	0	0	160	0	8	168
	SUBTOTAL SITEWORK			0	0	0	0	360	0	18	378
TOTAL	COST CODE 50102 WBS 327201			0	0	0	0	360	0	18	378
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327201.03	CONCRETE										
327201.0345602	GRADE & SCREED SOG	501	1840 SF	11	263	0	92	0	0	94	449
327201.0345604	FORM SOG	501	172 LF	14	353	0	155	0	0	135	643
327201.0345606	FORM FOOTINGS	501	252 SF	20	505	0	227	0	0	194	926
327201.0345608	FORM WALLS	501	504 SF	60	1514	0	454	0	0	522	2490
327201.0345610	KEY JOINTS	501	86 LF	4	96	0	43	0	0	37	176
327201.0345612	STRIP & OIL	501	756 SF	15	332	0	113	0	0	118	563
327201.0345614	CONCRETE FOOTINGS	501	10 CY	8	191	0	520	0	0	188	899
327201.0345616	CONCRETE SOG 6"	501	38 CY	30	717	0	1976	0	0	714	3407
327201.0345618	CONCRETE WALLS	501	10 CY	11	263	0	520	0	0	207	990
327201.0345620	CURING	501	2600 SF	13	287	0	39	0	0	86	412
327201.0345622	REBAR SLAB	501	2800 LBS	22	627	0	840	0	0	389	1856
327201.0345624	REBAR WALLS	501	1600 LBS	16	456	0	480	0	0	248	1184
327201.0345626	TROWEL FINISH	501	1840 SF	11	263	0	0	0	0	70	333
	SUBTOTAL CONCRETE			235	5,867	0	5,459	0	0	3,002	14,328
	SALES TAX 7.80%						426		0		426
	OH&P / B&I (ON MARKUPS ONLY)									113	113
TOTAL	COST CODE 50103 WBS 327201			235	5,867	0	5,885	0	0	3,115	14,867

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327201.07	MOISTURE AND THERMAL CONTROL										
327201.0765402	DAMPPROOFING	501	270 SF	5	126	0	65	0	0	51	242
327201.0765404	RIGID INSULATION	501	540 SF	5	126	0	108	0	0	62	296
327201.0765406	SEALANTS	501	1 JOB	8	202	0	200	0	0	107	509
	SUBTOTAL MOISTURE AND THERMAL CONTROL			18	454	0	373	0	0	220	1,047
	SALES TAX 7.80%						29		0		29
	OH&P / B&I (ON MARKUPS ONLY)									8	8
TOTAL	COST CODE 50107 WBS 327201			18	454	0	402	0	0	228	1,084
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327201.08	DOORS, WINDOWS AND GLASS										
327201.0876502	3/0 HM DOOR & FRAME EXT	501	3 EA	12	303	0	1950	0	0	597	2850
327201.0876504	3/0 HM DOOR & FRAME INT	501	5 EA	20	505	0	2750	0	0	863	4118
327201.0876506	6/0 HM DOOR & FRAME INT	501	1 EA	6	151	0	1100	0	0	332	1583
	SUBTOTAL DOORS, WINDOWS AND GLASS			38	959	0	5,800	0	0	1,792	8,551
	SALES TAX 7.80%						452		0		452
	OH&P / B&I (ON MARKUPS ONLY)									120	120
TOTAL	COST CODE 50108 WBS 327201			38	959	0	6,252	0	0	1,912	9,123
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327201.09	FINISHES										
327201.0987602	CONCRETE FLOOR SEALER	501	1330 SF	0	0	0	0	1663	0	83	1746
327201.0987604	PAINT DOORS	501	10 EA	0	0	0	0	350	0	18	368
327201.0987606	PAINT WALLS	501	2426 SF	0	0	0	0	873	0	44	917
327201.0987608	METAL STUD WALLS SHEETROCK ONE SIDE	501	770 SF	0	0	0	0	1309	0	65	1374
327201.0987610	METAL STUD WALLS SHEETROCK TWO SIDE	501	1656 SF	0	0	0	0	3643	0	182	3825
327201.0987612	VINYL TILE FLOORS	501	1014 SF	0	0	0	0	2535	0	127	2662
327201.0987614	SUSPENDED ACOUSTICAL TILE	501	1014 SF	0	0	0	0	1268	0	63	1331
327201.0987616	BASE 4"	501	468 LF	0	0	0	0	679	0	34	713
SUBTOTAL FINISHES				0	0	0	0	12,320	0	616	12,936
TOTAL	COST CODE 50109 WBS 327201 (ESCALATION 13.81% - CONTINGENCY 25.00%)			0	0	0	0	12,320	0	616	12,936
327201.10	SPECIALTIES										
327201.1012302	PAPER TOWEL DISPENSER	501	1 EA	1	25	0	300	0	0	86	411
327201.1012304	TOILET PAPER HOLDER	501	1 EA	1	25	0	20	0	0	12	57
327201.1012306	MIRRORS	501	1 EA	1	25	0	75	0	0	27	127
327201.1012308	SOAP DISPENSER	501	1 EA	1	25	0	50	0	0	20	95
327201.1012310	COAT HOOKS	501	5 EA	1	25	0	75	0	0	27	127
327201.1012312	TOILET SEAT COVER HOLDER	501	1 EA	1	25	0	65	0	0	24	114
327201.1012314	MOP HOLDER	501	4 EA	2	50	0	60	0	0	29	139
327201.1012316	COMPUTER FLOOR	501	540 SF	0	0	0	0	5670	0	284	5954
327201.1012318	DOOR SIGNAGE	501	9 EA	8	202	0	180	0	0	101	483

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
SUBTOTAL	SPECIALTIES			16	402	0	825	5,670	0	610	7,50
	SALES TAX 7.80%						64		0		6
	OH&P / B&I (ON MARKUPS ONLY)									17	1
TOTAL	COST CODE 50110 WBS 327201			16	402	0	889	5,670	0	627	7,58
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327201.13	SPECIAL CONSTRUCTION										
327201.1345602	STEEL BUILDING 50X43X14	501	2150 SF	0	0	0	0	48375	0	2419	5079
SUBTOTAL	SPECIAL CONSTRUCTION			0	0	0	0	48,375	0	2,419	50,79
TOTAL	COST CODE 50113 WBS 327201			0	0	0	0	48,375	0	2,419	50,79
	(ESCALATION 13.81% - CONTINGENCY 20.00%)										
TOTAL WBS 327201 FACILITY - OPERATIONS AREA				307	7,682	0	13,429	66,725	0	8,934	96,77

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327202	OPERATIONS AREA MECH.										
327202.15	MECHANICAL										
327202.1501000	****************************** FIRE PROTECTION & PLUMBING ******* ALLOW **********	501	0	0	0	0	0	0	0	0	0
327202.1501002	FIRE PROTECTION	501	5840 SF	0	0	0	0	13140	0	657	13797
327202.1501004	WATER CLOSET W/SEAT	501	1 EA	10	319	0	275	0	0	157	751
327202.1501006	LAVATORY W/TRIM	501	1 EA	8	255	0	150	0	0	107	512
327202.1501008	JANITOR SINK W/TRIM	501	1 EA	8	255	0	400	0	0	174	829
327202.1501010	WATER HEATER	501	1 EA	10	319	0	200	0	0	138	657
327202.1501012	SAFTY SHOWER / EYEWASH	501	1 EA	18	575	0	1200	0	0	470	2245
327202.1501014	REFIG DRINKING FOUNTAIN	501	1 EA	6	192	0	600	0	0	210	1002
327202.1501016	WATER PIPING W/FITTINGS	501	200 LF	60	1915	0	1000	0	0	772	3687
327202.1501018	SEWER & VENT W/FITTINGS	501	100 LF	20	638	0	300	0	0	249	1187
327202.1502000	****************************** HVAC ******************************	501	0	0	0	0	0	0	0	0	0
327202.1502002	EVAP COOLER PACE A-30 W/FARR FILTERS/CELL DEK MEDIA 17,500 CFM / 10 HP	501	1 EA	48	1200	0	15000	0	0	4293	20493
327202.1502004	SUPPORT FOR EVAP COOLER	501	1 EA	40	1000	0	500	0	0	398	1898
327202.1502006	INLET LOUVER 5' X 4' W/MANUAL DAMPER	501	1 EA	16	400	0	1000	0	0	371	1771
327202.1502008	UNIT HEATER 20 KW / T.T.	501	1 EA	8	200	0	600	0	0	212	1012
327202.1502010	UNIT HEATER 4 KW / T.T.	501	2 EA	16	400	0	600	0	0	265	1265
327202.1502012	UNIT HEATER 2.6KW / T.T.	501	1 EA	8	200	0	200	0	0	106	506
327202.1502014	UNIT HEATER 2.6KW / T.T.	501	1 EA	8	200	0	200	0	0	106	506
327202.1502016	EX. FAN 11,500 CFM W/CURB & MOTORIZED DAMPER	501	1 EA	40	1000	0	5000	0	0	1590	7590
327202.1502018	EX. FAN 440 CFM W/CURB & BACKDRAFT DAMPER	501	1 EA	8	200	0	200	0	0	106	506
327202.1502020	GRAVITY RELEIF HOOD 30" X 54"	501	1 EA	16	400	0	750	0	0	305	1455
327202.1502022	DUCT	501	3000 LBS	300	7497	0	1500	0	0	2384	11381
327202.1502024	REG W/DAMPERS	501	9 EA	18	450	0	1800	0	0	596	2846
327202.1502026	PIPING FOR WATER/DRAIN	501	100 LF	100	3192	0	500	0	0	978	4670
327202.1502028	TEST & BALANCE	501	1 LS	40	1277	0	0	0	0	338	1615
	SUBTOTAL MECHANICAL			806	22,084	0	31,975	13,140	0	14,982	82,181
	SALES TAX 7.80%						2494		0		2494
	OH&P / B&I (ON MARKUPS ONLY)									661	661

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL	COST CODE 50115 WBS 327202			806	22,084	0	34,469	13,140	0	15,643	85,336
	(ESCALATION 13.81% - CONTINGENCY 35.00%)										
TOTAL WBS 327202 OPERATIONS AREA MECH.				806	22,084	0	34,469	13,140	0	15,643	85,336

E70

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327203	OPERATIONS FACILITY ELECTRICAL										
327203.16	ELECTRICAL										
327203.1610301	20A 3W FEEDER - 1/2" EMT 3 #12 THHN CONDUCTORS HVAC FAN	501	50 LF	3	91	0	35	0	0	33	159
327203.1610304	65A 3W FEEDER - 1" EMT 3 #6 THHN CONDUCTORS HVAC HEATER FEEDER	501	50 LF	5	152	0	99	0	0	67	318
327203.1610321	20A 4W FEEDER - 1/2" EMT 4 #12 THHN CONDUCTORS HOT WATER FEEDER	501	100 LF	7	213	0	77	0	0	77	367
327203.1632006	1 X 4 INDUSTRIAL 2 LAMP ASSUME 1 FIXTURE 112 SF	501	6 EA	8	244	0	330	0	0	152	726
327203.1632008	COND & WIRE	501	1120 SF	17	518	0	327	0	0	224	1069
327203.1632010	1 X 4 INDUSTRIAL 2 LAMP W/EMERGENCY PAK 20% TO BE EMERG.	501	4 EA	8	244	0	820	0	0	282	1346
327203.1632012	2 X 4 TROFFER 4 LAMP	501	6 EA	10	305	0	390	0	0	184	879
327203.1632014	COND & WIRE	501	962 SF	29	884	0	454	0	0	355	1693
327203.1632016	2 X 4 TROFFER 4 LAMP W/EMERGENCY PAK	501	1 EA	2	61	0	225	0	0	76	362
327203.1632018	2 X 4 TROFFER 2 LAMP	501	3 EA	5	152	0	129	0	0	74	355
327203.1632020	2 X 4 TROFFER 2 LAMP W/EMERGENCY PAK	501	1 EA	2	61	0	205	0	0	70	336
327203.1632022	EXIT W/EMERGENCY PAK	501	4 EA	4	122	0	540	0	0	175	837
327203.1632024	WALL FIXTURE 55W LPS	501	3 EA	9	274	0	1260	0	0	407	1941
327203.1637026	RECPT & SW COND/WIRE	501	2082 SF	54	1645	0	679	0	0	616	2940
327203.1642014	FA CONSOLE W/ POWER SUPPLY & BATT. PACK 8 ZONE	501	1 EA	24	731	0	4490	0	0	1384	6605
327203.1642020	RADIO TRANSMITTER/ANTENNA & INTERFACE 8 ZONE F.A. MASTER BOX	501	1 EA	12	366	0	4000	0	0	1157	5523
327203.1642030	MANUAL FIRE ALARM STATION	501	4 EA	4	122	0	200	0	0	85	407
327203.1642033	FIRE ALARM GONG	501	2 EA	2	61	0	300	0	0	96	457
327203.1642036	SMOKE DETECTORS	501	6 EA	6	183	0	690	0	0	231	1104
327203.1642037	HEAT DETECTORS	501	2 EA	4	122	0	430	0	0	146	698
327203.1642139	CONNECT SPRINKLER PIV VALVE	501	1 JOB	4	122	0	25	0	0	39	186
327203.1642142	CONNECT SPRINKLER FLOW SW	501	1 JOB	4	122	0	25	0	0	39	186
327203.1642144	CONDUIT & WIRE ALLOWANCE	501	1 JOB	40	1219	0	1200	0	0	641	3060
327203.1661111	SQD H321NRB 30A-240V-4SN NEMA 3R EF-2	501	1 EA	3	91	0	118	0	0	55	264

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327203.1661211	SQD H361RB 30A-600V-3P NEMA 3R SWITCH HVAC FAN SW	501	1 EA	3	91	0	190	0	0	74	355
327203.1662002	225A 208Y/120V POWER PNL	501	1 LA	36	1097	0	1250	0	0	622	2969
327203.1662004	100A 480Y/277V POWER PNL	501	1 EA	11	335	0	750	0	0	288	1373
327203.1664106	45 KVA DRY-TYPE TFMR 3 PH 480V-208/120Y	501	1 EA	17	518	0	1615	0	0	565	2698
327203.1668015	*** HEAT *** ASSUME 31237 CF OF AIR TO BE HEATED ASSUME 59 BTU LOSS	501	0	0	0	0	0	0	0	0	0
327203.1668016	HVAC HTR 36 KW 480V W/ REMOTE STAT CONNECT	501	1 EA	16	487	0	140	0	0	166	793
327203.1668700	120V 1/2 HP MOTOR EF-2 CONNECTION	501	1 EA	1	30	0	9	0	0	10	49
327203.1668701	480V 10 HP MOTOR HVAC FAN CONNECTION	501	50 EA	75	2285	0	443	0	0	723	3451
327203.1668710	480V 2000W HOT WATER TANK CONNECTION	501	1 EA	1	30	0	9	0	0	10	49
327203.1668800	120V 1/2 HP MOTOR EF-2 FEEDER, (0.50"GRS W/#12) ON ROOF	501	50 LF	7	213	0	85	0	0	79	377
SUBTOTAL	ELECTRICAL			433	13,191	0	21,539	0	0	9,202	43,932
	SALES TAX 7.80%						1680		0		1680
	OH&P / B&I (ON MARKUPS ONLY)									445	445
TOTAL	COST CODE 50116 WBS 327203			433	13,191	0	23,219	0	0	9,647	46,057

(ESCALATION 13.81% - CONTINGENCY 25.00%)

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
327203.1662008	60A 208Y/120V UPS PNL	7060	1 EA	13	396	0	519	0	0	242	1157
327203.1664206	18.75 KVA UPS	7060	1 EA	17	518	0	28000	0	0	7557	36075
327203.1666010	MCC-1 480V 1200A 1 EA 1200AF/1200AT M.C.B 1 EA 1200AF/1000AT C.B.	7060	1 EA	0	0	0	0	0	0	0	0
327203.1666020	1 EA SIZE 2 MCP 4 EA SIZE 1 MCP	7060	1 EA	0	0	0	0	0	0	0	0

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	6 EA SIZE 1 SPACE										
327203.1666030	1 EA 100AF/100AT C.B.	7060	1 EA	75	2285	0	26000	0	0	7496	35781
327203.1666040	MCC-2	7060	1 EA	0	0	0	0	0	0	0	0
	1 EA 800AF/800AT MCB										
	1 EA 800AF/700AT										
327203.1666050	4 EA 100AF/30AT C.B.	7060	1 EA	74	2287	0	27000	0	0	7761	37048
	1 EA 100AF/70AT C.B.										
	6 EA SIZE 1 MCP										
SUBTOTAL ELECTRICAL				179	5,486	0	81,519	0	0	23,056	110,061
	SALES TAX 7.80%										
	OH&P / B&I (ON MARKUPS ONLY)						6358		0		6358
										1685	1685
TOTAL	COST CODE 70616 WBS 327203			179	5,486	0	87,877	0	0	24,741	118,104
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
327203.1610011	*** PROCESS *** INSTRM/CONTROL	7065	0	0	0	0	0	0	0	0	0
327203.1684000	** PROCESS INSTRUMENTATION *	7065	0	0	0	0	0	0	0	0	0
327203.1684002	PROCESS MONITORING AND PROCESS CONTROL SYSTEM (PMMCS)	7065	1 EA	40	1219	0	28000	5000	0	8743	42962
327203.1684003	1 EA PROGRAMMABLE CONTROLLER (GOULD 984	7065	1 EA	0	0	0	0	0	0	0	0
	5 EA OPERATOR STATION										
327203.1684004	5 EA FUNCTIONAL KEYBOARD	7065	1 EA	0	0	0	0	0	0	0	0
	5 EA COMPUTER AT										
	1 EA DOT MATRIX PRINTER										
327203.1684005	20 EA ANALOG I/O,AI/O	7065	1 EA	0	0	0	0	0	0	0	0
	120 EA DISCRETE I/O,DI/O										
	20% SPARE OF THE ABOVE										
327203.1684006	ASSUME PROGRAMING OF THE PROGRAMMABLE CONTROLLER BY DESIGN CONSTRUCT	7065	1 EA	0	0	0	0	2000	0	400	2400
327203.1684007	ALLOW ONE WK TO TEACH WHC PROGRAMMABLE CONTROLLER	7065	1 EA	0	0	0	0	1500	0	300	1800
327203.1684008	20 EA ANALOG I/O,AI/O	7065	1 JOB	80	2438	0	0	0	0	646	3084

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
	120 EA DISCRETE I/O,DI/O TERM										
SUBTOTAL	ELECTRICAL			120	3,657	0	28,000	8,500	0	10,089	50,246
	SALES TAX 7.80%						2184		0		2184
	OH&P / B&I (ON MARKUPS ONLY)									579	579
TOTAL	COST CODE 70616 WBS 327203			120	3,657	0	30,184	8,500	0	10,668	53,009
	(ESCALATION 13.81% - CONTINGENCY 25.00%)										
TOTAL WBS 327203 OPERATIONS FACILITY ELECTRICAL				732	22,334	0	141,281	8,500	0	45,056	217,170

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
328000	DISCHARGE LINE										
328000.02	SITEWORK										
328000.0200002	EXCAVATION AND BACKFILL FOR 8" OUTFALL LINE	700	350 CY	0	0	0	0	2013	0	101	2114
328000.0200004	8" SCH 80 PVC PIPE	700	920 LF	129	4118	0	4370	0	0	2249	10737
328000.0200006	8" SCH 80 PVC COUPLING	700	46 EA	0	0	0	690	0	0	183	873
328000.0200008	MANHOLES	700	4 EA	32	1021	0	1800	0	0	748	3569
328000.0200010	OUTFALL STRUCTURE (ALLOW)	700	1 EA	40	1277	0	1000	0	0	603	2880
SUBTOTAL	SITEWORK			201	6,416	0	7,860	2,013	0	3,884	20,173
	SALES TAX 7.80%						613		0		613
	OH&P / B&I (ON MARKUPS ONLY)									162	162
TOTAL	COST CODE 70002 WBS 328000			201	6,416	0	8,473	2,013	0	4,046	20,949

(ESCALATION 13.81% - CONTINGENCY 25.00%)

	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL WBS 328000 DISCHARGE LINE	201	6,416	0	8,473	2,013	0	4,046	20,949

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
330000	OPERATING CONTRACTOR										
330000.02	SITEWORK										
330000.0200000	BURIAL CHARGES	700	1566 CF	0	0	0	0	49251	0	0	49251
SUBTOTAL	SITEWORK			0	0	0	0	49,251	0	0	49,251
TOTAL	COST CODE 70002 WBS 330000			0	0	0	0	49,251	0	0	49,251
	(ESCALATION 12.46% - CONTINGENCY 25.00%)										
330000.16	ELECTRICAL										
330000.1622225	UTILITY TERM,EQUIP TEST ALLOW	6150	1 JOB	0	0	0	0	15000	0	0	15000
SUBTOTAL	ELECTRICAL			0	0	0	0	15,000	0	0	15,000
TOTAL	COST CODE 61516 WBS 330000			0	0	0	0	15,000	0	0	15,000
	(ESCALATION 12.46% - CONTINGENCY 25.00%)										
330000.1684007	ALLOW ONE WK TO TEACH WHC PROGRAMMABLE CONTROLLER	7065	1 EA	0	0	0	0	15000	0	0	15000
SUBTOTAL	ELECTRICAL			0	0	0	0	15,000	0	0	15,000

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
TOTAL	COST CODE 70616 WBS 330000			0	0	0	0	15,000	0	0	15,000
	(ESCALATION 12.46% - CONTINGENCY 25.00%)										
TOTAL WBS 330000 OPERATING CONTRACTOR				0	0	0	0	79,251	0	0	79,251

E77

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
340000	PROJECT MANAGEMENT										
340000.19	PROJECT MANAGEMENT										
340000.1900000	PROJECT MANAGEMENT	700	1 LS	0	0	0	0	478000	0	0	478000
340000.1900001	PSAR	700	1 LS	0	0	0	0	150000	0	0	150000
340000.1900002	FSAR	700	1 LS	0	0	0	0	250000	0	0	250000
SUBTOTAL	PROJECT MANAGEMENT			0	0	0	0	878,000	0	0	878,000
TOTAL	COST CODE 70019 WBS 340000			0	0	0	0	878,000	0	0	878,000
	(ESCALATION 12.46% - CONTINGENCY 20.00%)										
TOTAL WBS 340000 PROJECT MANAGEMENT				0	0	0	0	878,000	0	0	878,000

ACCOUNT NUMBER	DESCRIPTION	COST CODE	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	OH&P / B & I	TOTAL DOLLARS
REPORT TOTAL				27,906	758,545	0	3,807,732	3,738,761	0	1,391,509	9,696,547

APPENDIX F

WHC LABORATORY SAMPLE ANALYSIS SCHEDULES

Westinghouse Hanford Company

Internal Memo

12740-90-020

From: 222-S/RCRA Analytical Laboratories
Phone: 3-5669 MO-039/200W T6-07
Date: March 27, 1990
Subject: LABORATORY SAMPLE ANALYSIS SCHEDULES

To:

M. R. Adams	H4-55	J. H. Kessner	T6-08
N. C. Boyter	R2-52	E. J. Kosiancic	R2-67
J. D. Briggs	T6-14	T. A. Lane	T6-07
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A. J. DiLiberto	R2-12	L. L. Powers	B2-35
V. W. Hall	B2-15	L. H. Taylor	T6-16
S. M. Joyce	T6-08	R. D. Wojtasek	B2-15

cc: CRS File/LB

The following Laboratory sample schedules for protocol analyses shall be utilized for Environmental Restoration Tri-Party Agreement (TPA) activities. Laboratory analysis and quality assurance documentation, excluding validation, shall not exceed the following schedule (see attachments):

1. Single-Shell Tank Analyses (complete core) - 180 days
2. TRU and Hot Cell Analyses - 140 days
3. Low-Level and Mixed Waste (up to 100 mr/hr) Analyses - 90 days
4. Nonradioactive Waste Analyses - 50 days

Sample analyses schedules for specific activities can be evaluated to determine if reduced or lengthened times are appropriate.

If you have any questions, please contact Joan Kessner on 373-3507.

Curtis R Stroup

C. R. Stroup
Manager

pjm

Attachments.

BASES

1. Single-Shell Tank Analyses

Figure 1 is a subsample breakdown of a Phase 1A Single-Shell Tank Waste Characterization Segment Sample. An average of five segment samples and one composite sample are considered one complete single-shell tank core analysis. One hundred and eighty days shall be utilized as the time required to complete a TPA protocol analyses. This time includes initial segment receipt at Laboratory to final data package submittal to the Office of Sample Management for validation.

Assumptions

- o Critical Path Work

-- Hot Cell Sample Preparation	23 days*
-- Radiological Analyses	90 days
-- Data Package Preparation	10 days
-- QA Review/Approval	5 days
	128 days

- o At ~70% operating efficiency

$$\frac{128 \text{ days}}{0.7} = 180 \text{ days}$$

- o Hot cell preparation includes receipt of all segments during first two weeks.
- o Hot cell preparation activities conducted on day shift only, with 5 work days per week.
- o Hot cell analyses can be conducted 24 hr/day, 5 work days per week.
- o Radiological analyses are performed by three and a half equivalent full-time personnel.

*See Attachment 2.

2. TRU and Hot Cell Activities

Figure 2 is a breakdown on generic analyses requirements.

Assumptions

- Critical Path Work

-- Glovebox or Hot Cell Preparation	10 days
-- Radiological Analyses	73 days
-- Data Package Preparation	10 days
-- QA Review	5 days
	98 days

- At ~70% operating efficiency

$$\frac{98 \text{ days}}{0.7} = 140 \text{ days}$$

- Hot cell activities can be conducted 24 hr/day, 5 work days per week.

- Assume 20% reduction in radiological analyses required for SST analyses. Work based on three and a half equivalent full-time personnel.

3. **Low-Level and Mixed Waste (up to 100 mr/hour) Analyses**

Figure 2 is a breakdown on generic analyses requirements.

Assumptions

o Critical Path Work

-- Sample Preparation	2 days
-- Radiological Analyses	46 days
-- Data Package Preparation	10 days
-- QA Review	5 days
	63 days

o At -70% operating efficiency

$$\frac{63 \text{ days}}{0.7} = 90 \text{ days}$$

o Assume 50% reduction in radiological analyses required for SST analyses. Work based on three and a half equivalent full-time personnel.

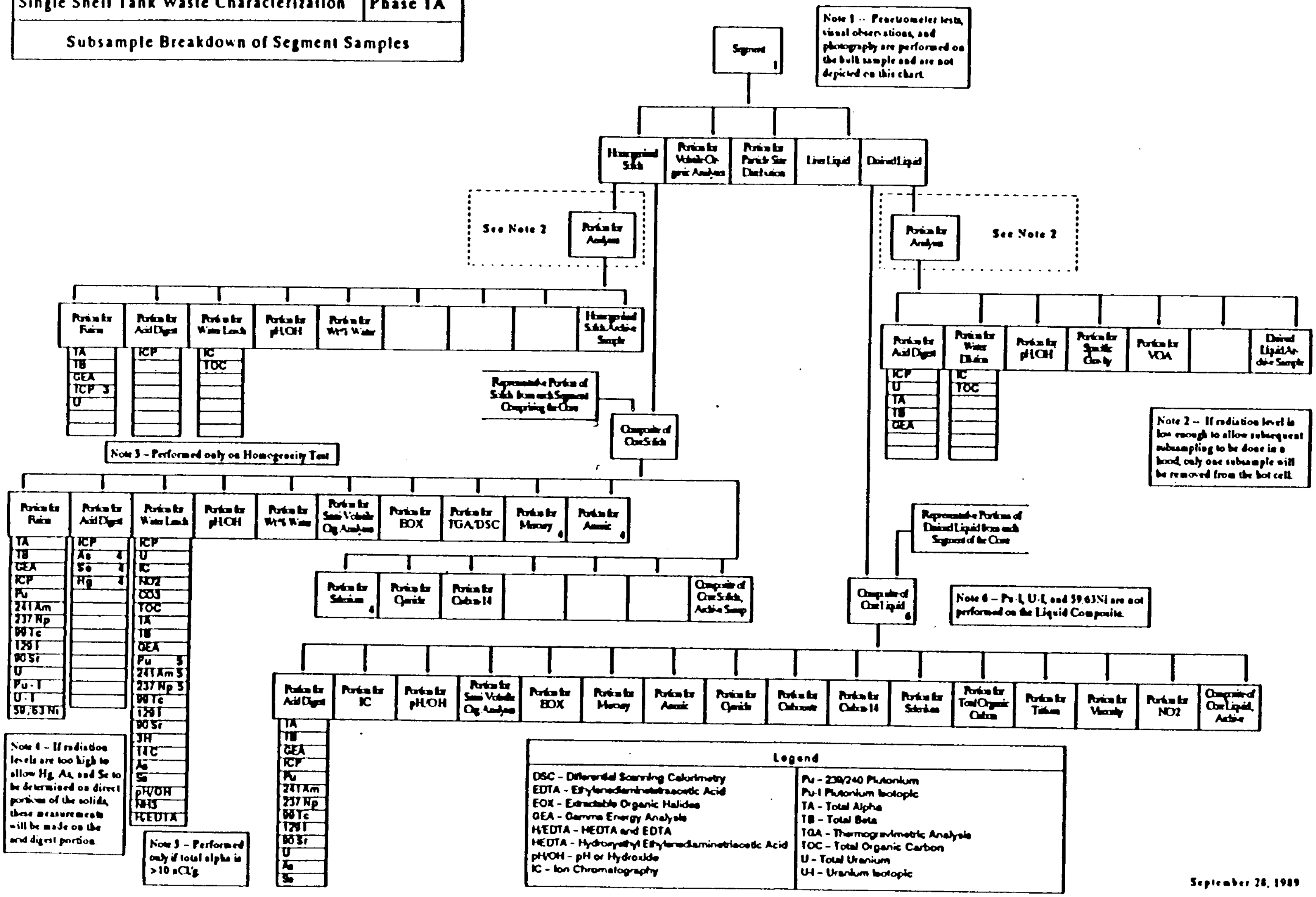
4. Nonradioactive Waste Analyses

This work will normally be subcontracted. The 50-day time period reflects actual experience on 1100 Area sample analyses activities. Sample screening analyses conducted onsite reflect the first'7 days of the 50-day period. Minimal radiological analyses are required.

Figure 1

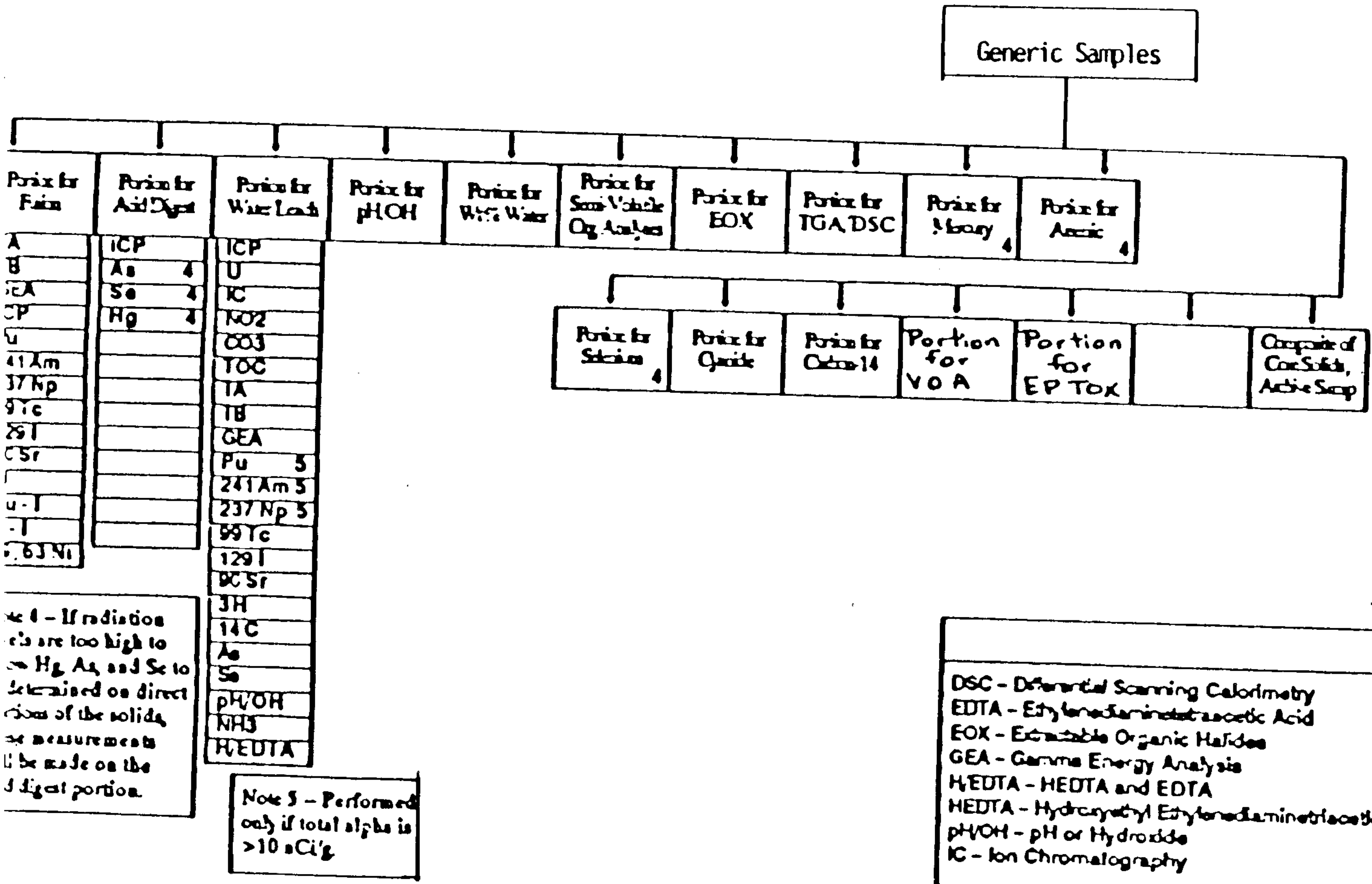
Single Shell Tank Waste Characterization | Phase 1A

Subsample Breakdown of Segment Samples



September 28, 1989

FIG. 2



Legend

DSC - Differential Scanning Calorimetry	Pu - 239/240 Plutonium
EDTA - Ethylenediaminetetraacetic Acid	Pu-I Plutonium Isotopic
EOX - Extractable Organic Halides	TA - Total Alpha
GEA - Gamma Energy Analysis	TB - Total Beta
H/EDTA - HEDTA and EDTA	TGA - Thermogravimetric Analysis
HEDTA - Hydroxyethyl Ethylenediaminetriacetic Acid	TOC - Total Organic Carbon
pH/OH - pH or Hydroxide	U - Total Uranium
IC - Ion Chromatography	U-I - Uranium Isotopic

are observed or sensed by the operator must be telemetered and displayed remotely. The use of television cameras and audio transmitters in the shielded enclosure provides the normal sensory information to the operator. Additional information regarding the process functions normally is supplied by one of the many forms of instrumentation that transmits to a central control panel. The sensor for any measurable parameter is located in an environment that includes a radiation field in addition to the environment created by the quantity being measured; therefore, some caution must be exercised in the development or selection of sensor materials (7).

The design of complex machines for radioactive environments has proceeded on a broad philosophical base. Approaches vary from the utilization of commercially available equipment, which is used until it malfunctions and then is discarded and replaced, to the design of equipment in which all components can be repaired remotely or replaced. Recent designs favor a compromise: a modular design where functions that have similar reliabilities are grouped together and constitute a removable module. The cost compromises in design are the closer tolerances required for mating parts versus the cost and time delays of replacing principal segments of a machine. A recent example of modular design in a fuel-shearing machine is shown in Figures 2 and 3. Two levels of modularization are displayed. Principal modules are designed to be replaced when wear or malfunction is detected. Replacement modules are available so that operational delays are minimized. The module being replaced is designed so that it can be moved to a repair area where it can be disassembled remotely and repairs and replacements can be made. The repaired unit then becomes the spare. This approach is particularly valuable in instances where wear, eg, of shear blades, is predictable. The described approach requires that the facility have a remotely operated repair area. Repair areas increase the capital costs of the facility, but the alternative to repair and reuse is the added cost of radioactive disposal.

One of the key factors in implementing the design of a remotely operated and maintained piece of equipment is the capability of the manipulator that is employed; the norm is a manipulator that is similar to a person accomplishing both operation and maintenance. Manipulators vary in their ability to duplicate human capabilities.

Table 1. Comparison of Times Needed for an Operator or a Manipulative Device to Perform Typical Tasks

	Organization conducting performance study				
	LASL[a]	MIT[b]	NASA[c]	MBA[d]	CEA[e]
two-armed operator (unsuited)	1	1	1	1	1
two-armed operator (suited)				8	
two-armed mechanical master/slave	8	8–10	8	8	2–8
one-armed mechanical master/slave	16		16		
one-armed electromechanical manipulator (position control)	80	40–50	64	55	10–30
one-armed electromechanical manipulator (switch control)	480	80–100	640		50–100
crane (impact wrench)	>500	>100	>600	>500	>100

[a] Ref. 10. LASL = Los Alamos Scientific Laboratory.
[b] Ref. 11. MIT = Massachusetts Institute of Technology.
[c] Ref. 12. NASA = National Aeronautics and Space Administration.
[d] Ref. 13. MBA = MB Associates.
[e] Ref. 14. CEA = Commissariat à l'Énergie Atomique.

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Note: To obtain additional copies of this report contact Brian Sprouse 6-2530.